The Electrical World.

VOL. XXX. NEW YORK, DECEMBER 4, 1897. No. 23.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

253 Broadway, New York.

Established 1874. Incorporated 1889.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.

Western Office, 936 Monadnock Block, Chicago.

Philadelphia Office, 929 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,

In the United States, Canada or Mexico; other foreign countries, $6.00.

In requesting your address changed give OLD as well as new address.

Now in its third decade, THE ELECTRICAL WORLD is the Pioneer Electrical Journal of America, and has well maintained its lead. It has the largest Circulation of any electrical periodical, and is the best Advertising Medium.

THE ELECTRICAL WORLD'S Advertising Rates are much lower than those of any other similar publication, circulation considered, and vary according to space, position and number of insertions. Quotations promptly furnished.

Address and make drafts, orders, etc., payable to

THE ELECTRICAL WORLD,

253 Broadway, New York.

VOL. XXX. NEW YORK, DECEMBER 4, 1897. No. 23.

CONTENTS.

Editorials 657
The Flushing Electric Light and Power Station 659
Walker Company Owned by Four Men 661
The Lighting and Power Stations of the Richmond Railway and Electric Company 662
Setting Up Large Generators, by George T. Hanchett 665
The Enlargement of the Niagara-Buffalo Transmission Line 667
A Modern English Central Station 668
An Electric Curve Tracer, II., by Prof. Edward B. Rosa 670
Small Lighting Plants, by Frederick C. Reeve 672
The Tendency of Central Station Development, I. 673
Digest of Current Electrical Articles, compiled by Carl Hering 675
An Improved Enclosed Arc Lamp 681
The Construction of Engine Type Alternators 681
Steam and Oil Separator 682
Decorative and Miniature Lamps 682
A Modern Gear Plant 683
An Electrical Education by Mail 683
Electric Railway at the Brussels Exposition 684
Direct-Connected Multipolar Generator 684

Departments:

Financial Intelligence 685
Special Correspondence 685
General News 688
Personal Notes 689
Obituary Note 690
Trade and Industrial Notes 690
Business Notices 691
Illustrated Record of Electrical Patents 691

THE CENTRAL STATION AND THE ISOLATED PLANT.

One of the most serious problems now confronting central station managers is the growth of the fashion for the installation of isolated plants in large buildings. So far no one has laid down a sharp line of demarcation marking the point at which it becomes more expensive for the consumer to make his own current than it is for him to buy it from the central station. An isolated plant seems to be regarded as a necessary part of the equipment of most new office buildings, hotels, theatres, large stores and the like, and one is installed as a matter of course in such buildings without any particular inquiry as to whether or not it will supply light at a more reasonable price than the station. Such installations are for the moment the fashion, and even in engineering there are fashions and a blind following of tradition and custom frequently unreasonable.

The result of the increase of these isolated plants is that the central station finds itself deprived of a valuable class of custom, while the users of light thus generating current on their own premises do so at a loss in many cases. The desideratum is to wean the owners of the isolated plants from their belief in these as profitable investments and to convert them into customers for the central station.

The difficulty that has been standing in the way of this is one whose basis is a certain imperfection of human nature. When a definite payment of lump sums in cash becomes necessary at the end of each month the totals appear larger than where even greater expenses are scattered through many items, and occur at various times. This seems to be exactly the case with many isolated plants. The coal bill, the oil bill, the bill for repairs, for wages, for this, that and the other thing, that go to make up the total, are compared with the single account rendered for service from the central station to the detriment of the latter, while a more reasonable study of the two would probably show that the former is the greater expense. What is needed is a method by which current can be sold cheaply to the present users of isolated plants, so that they may in some measure continue to enjoy the advantages of partial independence in the matter of light that now constitutes one of the principal advantages of such a plant. The suggestion below is offered as one which may easily to put into effect, and which will most likely lead to results beneficial alike to the station and to the customer.

Let the user of lights replace his plant with a storage battery which can receive charging current from the central station at such hours as may be most convenient for the latter, and when it can be furnished at the least cost. Then, if the losses in the battery and the cost of its maintenance and depreciation are less than the saving in the cost of current, this is all that is necessary to provide service that is less expensive than that of the ordinary direct connection to the central station mains, far less expensive in many cases than that given by the isolated plant, and profitable in this way both to the station and the consumer. In fact, the general introduction of such a system would result in the immediate great improvement in the load factor of central stations, thus distributing current and probably give more satisfaction than any other system which has been suggested.

Of course the suggestion immediately occurs that it might be better to consolidate the various storage battery plants thus outlined into one large battery at the central station, and in this way secure the same smoothing of the load curve of the station. While this plan is an excellent one and useful in almost every case, still it does not give to the individual consumer of large numbers of lights in one place that independence of the central station which is now secured to him by the use of the isolated plant. It is probable that the elimination of the isolated plant as a factor of great importance in our city services will be one of the direct results of further improvements in storage batteries. Even with the losses and the somewhat high maintenance cost of these at present, however, they are sufficiently good to work the revolution suggested if they are handled in the proper way. Central station managers who have contended with the problem of isolated plants in their territory will probably find it worth while to carefully study the possibilities of some such method of storage battery service as that described, and will almost certainly find that they will be able to give by this method a service considerably less expensive to the user, and at the same time more profitable to themselves.

ENCLOSED ARC LAMPS FOR STREET LIGHTING.

The enclosed arc lamp on a constant potential direct-current circuit possesses some very great advantages over the usual form of open arc lamp on a series circuit for street lighting, and its growing use indicates that station managers are beginning to appreciate these, especially where a three-wire or other system of direct-current constant potential supply is already in use. So many elements have to be considered in comparing the availability of the two types that it is hard to say definitely how much advantage is possessed by the former, but it can be at least shown that it has many features which commend its use for street lighting.

In situations where the wiring is underground an important saving in the rent or maintenance of the ducts now used for series arc wires is at once effected by the use of enclosed arcs burning across the constant-potential mains. The elimination of the high-pressure arc wires also serves to reduce the troubles of defective insulation, and to take away the element of danger always connected with their use. The trimming of lamps burning 100 to 150 hours requires a smaller force of men. The light is more steady and less affected by wind, while the objectionable collection of scorched insects in the globes is rendered impossible.

The great saving is not on the line or in the lamp, but at the station. The substitution of constant potential generators for the series arc machines means the simplification of the station and switchboard, an enormous gain in flexibility, and a great increase in the efficiency of generation of current. Since the street lighting load is now almost universally an all-night load, the load factor of the constant-potential generators will be improved by carrying it on them, while the homogeneity of the station will result in the simplifying of the generating mechanism in many ways. Attendance will also be lessened, as will the depreciation and repair account. In storage-battery and rotary transformer sub-station distribution, now coming to be recognized as the best system for extended electrical supply over large city areas, the load factor of the rotaries and batteries is bettered by the use of these lamps on the low-voltage incandescent circuits, and the sub-stations themselves simplified by the elimination of rectifiers or motor-driven constant-current generators.

On the other side it may be said that the enclosed lamps thus connected must be lighted and extinguished individually, that the carbons consumed in them are of high cost as compared with those used in the ordinary open arc, that considerably more copper is requisite for an extended distribution, and that there is a substantial waste of energy in the resistance coils which are a necessary feature of the enclosed arc lamp. Admitting these objections it still appears that the gains incident to the use of this method of street illumination more than offset them.

A TYPICAL PLANT.

There are in operation to-day in many of our second-class cities electric light and power plants whose beginnings were installed in the early years of electric lighting. Central station practice has changed and new types of machinery and new methods of distribution have been evolved, but here and there may still be seen an example of the older station at work and giving a fairly satisfactory service. One of the most typical and interesting of these, at Richmond, Va., is illustrated and described in another column.

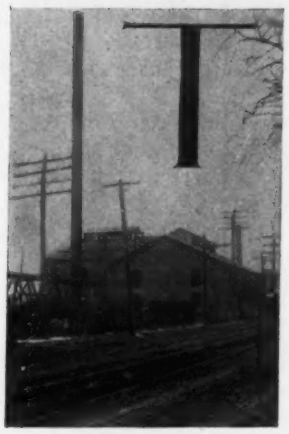
The feature which most impresses one who considers the operation of a central station of this character is the really remarkable availability of the ancient types of generators. Efficiency is, after all, a sort of abstraction, and the real factor to be considered in any installation is availability—the ability of the plant to do the work required of it, with due consideration of all the elements, electrical, mechanical and financial, of its situation, environment and necessities. Such a plant as this does its work and does it well, though not so well as a new and more modern installation would. The true ends and objects of an electric light station are twofold, to make light and to earn money. Since the former is a necessary preliminary to the latter it may be said that earning money is its sole *raison d'être*. If it does this successfully its factor of availability is high.

Another striking feature of the Richmond plant is the fact that some of its generators have been in continuous service for over ten years. This speaks volumes for the excellence of the construction of electrical machinery at that time, and is an indication of what great permanence may be expected from present types, which are far more carefully manufactured.

MOONLIGHT SCHEDULE FOR 1898.

Since July 1, 1890, The Electrical World has regularly issued, for the benefit of its subscribers who are managers of central stations, a Moonlight Schedule for each day of each month, showing the time for turning lights on and off. These moonlight tables are compiled by Mr. H. W. Frund, and are based on local mean time. They have now become so standard that they are used by central station managers in all sections of the country. At first the Moonlight Schedule was published in The Electrical World monthly, but it was thought that the tables would be of greater convenience to the managers if those for the entire year were printed in advance on a single sheet, so that they might be framed and put up in the station for ready reference. For the past two years this has been done, the tables being sent out as a supplement to the paper. Managers cordially approved the change. This year another change has been made, which it is believed will render the Moonlight Schedule even more popular. The tables for 1898 have been printed on heavier paper, and instead of being mailed with The Electrical World are sent in separate envelopes to every central station mentioned in Johnston's Electrical and Street Railway Directory. For this reason the Moonlight Schedule is not sent to subscribers other than electric light companies. Any subscriber or reader, however, who wishes a copy will be mailed one free of charge on application.

The Flushing Electric Light and Power Station.



THE small electric station, as well as the large one, has its interest for the engineer, and although the apparent magnitude of the undertaking of the one is small in comparison with that of the other, the problems involved in the small station are often more difficult of solution, and are of a peculiar kind. It may, in fact, be safely said that the engineering ability required to design the smaller plant is of quite as high class as that needed for the larger, being concerned with the question not of handling a variable quantity at wholesale, warranting the employment of all the little and big economies which engineering ability has devised, but of handling a *more* variable quantity at retail—on a scale which would render the above referred-to economies in such cases extravagances, and yet produce a fairly economical mechanism.

This latter problem is the one that was presented in the city of Flushing, L. I., a small but thrifty and growing community, which had already outgrown one plant, but which, with the metropolitan bee buzzing in its ears, demanded something more modern than had done service in its village days.

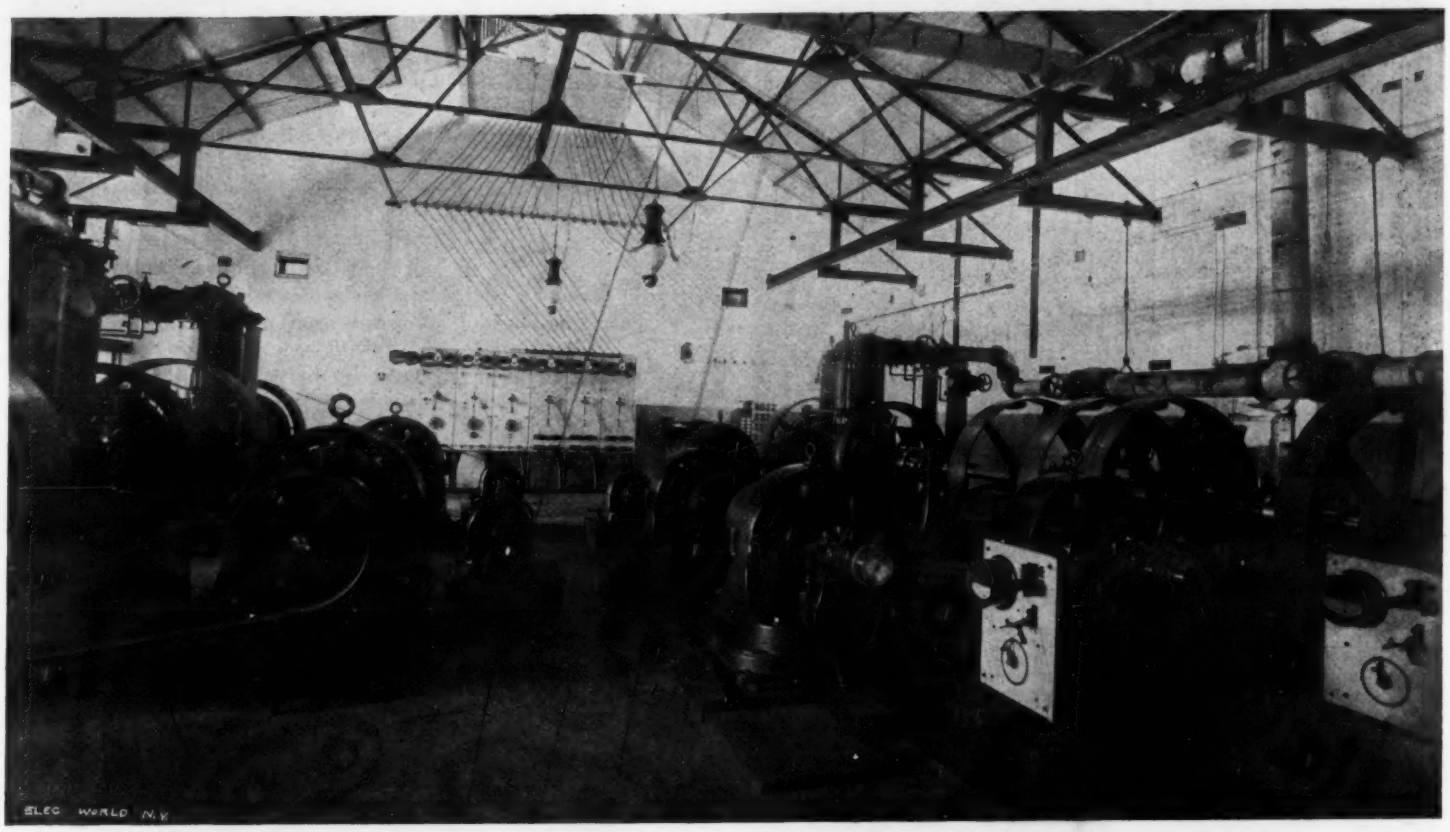
The situation was not far different from that which is found in many other small communities consisting largely of residences somewhat widely scattered and small retail stores, the characteristic of the service being an extremely low load factor. To meet this service economically, to provide for a small already existing power demand, and which it was the desire to cultivate and increase in the future, and to provide direct current arc lighting for the streets and stores, were the particular conditions Mr. F. H. Thompson, the mechanical engineer of the company, and Messrs. Westinghouse, Church, Kerr & Co., the contracting engineers, who designed and installed the plant, were required to meet, and the result, as will be seen from the following description, is an exceedingly compact and flexible design.

The buildings, located on a narrow strip of land lying between the water and Lawrence Street, near Bridge Street, consist of two communicating structures, in one of which is located the steam generating apparatus, and in the other the engines, dynamos and offices. They were both built by the Berlin Iron Bridge Company, and consist of skeleton steel construction, filled in with brick. The roofs are of corrugated iron, carried on steel trusses, with monitors on each, providing ample ventilation and light. In the engine room the roof is lined with the Berlin Iron Bridge Company's non-conducting, fireproof, non-condensing lining. In both the boiler and engine rooms the floor is one solid body of concrete, and the whole is absolutely fireproof.

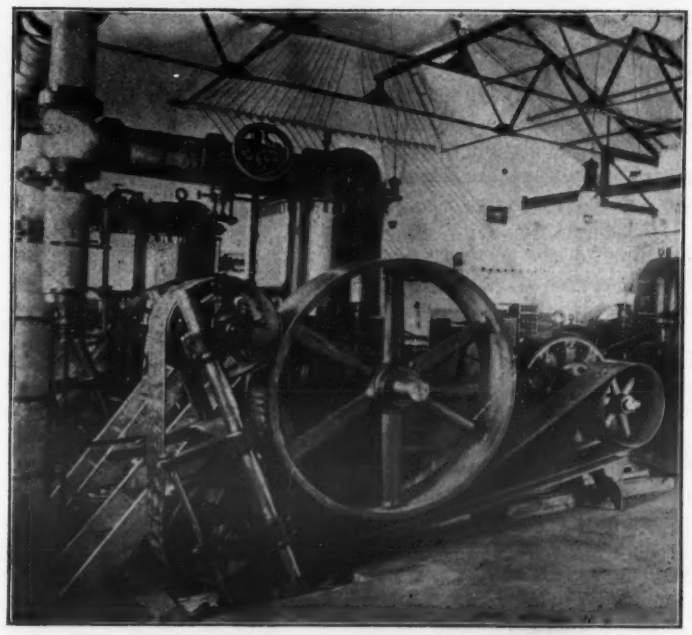
THE BOILER HOUSE.

This building, which faces on the water, occupies a ground area of 40 feet 6 inches by 40 feet, and is equipped with four 61-inch Manning high pressure boilers, each of 130 horse-power, centennial rating. These are arranged along one side of the room, and adjoining them, next to the dynamo room, are located the boiler-feed pumps, which are the Dean duplex, 6 x 4 x 6 inches.

Beneath the building the company has sunk an artesian well, from which the boiler supply is taken by a low service steam pump, and discharged either into a larger tank just outside or directly into



THE INTERIOR OF THE FLUSHING ELECTRIC LIGHT AND POWER STATION.

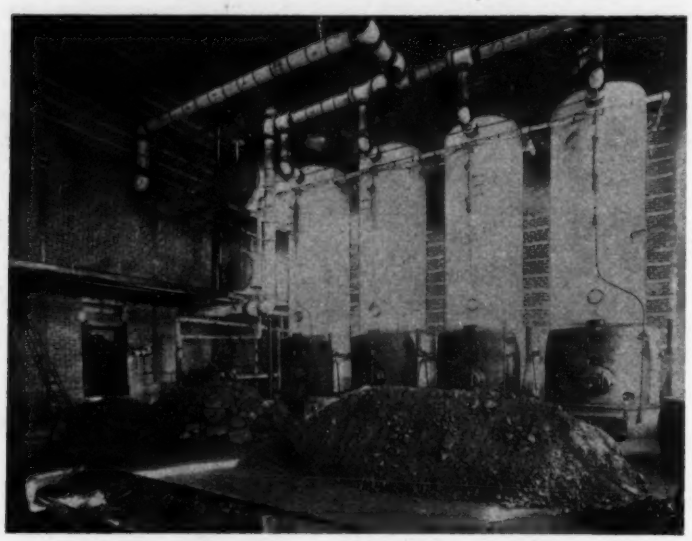


ENGINE AND L. P. & D. TRANSMITTER IN FLUSHING STATION

the exhaust steam heater. Arrangements are made, however, so that the pumps can draw either from the exhaust heater, the tank, the well, or the city water mains.

Directly over the condensers, and therefore occupying no otherwise useful space, are located the live steam purifier and exhaust steam heater. The Hoppes system of feed-water purifying is used, rendered necessary by the quality of the water, which is not the best, the water being usually pumped from the well by the low-service system into the exhaust heater, and thence by the boiler feed pumps into the live steam purifier, whence it descends by gravity into the boilers, the elevation of the purifier being sufficient for this purpose.

The steam for operating all of the auxiliaries is ordinarily taken from the live steam purifier, instead of from the boilers direct, so as to provide circulation in the purifier, but provision is made,



The Boilers at the Flushing Station.

by means of a supplementary header connected with each boiler, to permit direct connections in case the purifier is for any reason out of service. The exhaust from all the auxiliaries is discharged into the heater.

The condensers, which are also located in this corner of the building, are of the Dean independent type, in pairs, and are arranged with by-passes, so that either condenser can be run with any combination of engines. The exhaust pipes are provided with automatic-relief valves, and the condensers are supplied with salt water through cast-iron suction pipes.

The above equipment occupies one side of the boiler house, the foundations for an exact duplicate being provided on the other side. Thus it will be seen that within an area of 1620 square feet of floor space there is provided generating capacity for 1040 horse-power, centennial rating, or about 1 horse-power to each 1.5 square feet, including all auxiliaries, pumps, condensers, steam heaters, purifiers and coal room.

Just without the boiler room is located the stack, which is worthy of notice. This is a steel cylinder 54 inches in diameter and 125 feet high, weighing 24,000 pounds, and was erected in one piece. Its foundation consists of a solid block of concrete 15 feet square and 10 feet deep, laid on piles. On account of the narrowness of the property, which is bounded on the one side by the street and on the other by the water, it was impossible to support this tall shaft by guy wires, so it was necessary to design it to be self-supporting.

ENGINE AND DYNAMO-ROOM.

This building, exclusive of the offices, which are partitioned off at one end of the room, is connected with the boiler house by a single door, and measure 41 x 48 feet inside. It contains, besides overhead cranes running the entire length of the room, four Westinghouse compound automatic engines, with cylinders measuring 12 and 20 by 12 inches, and indicating 150 horse-power when operating condensing at 123 pounds of steam.

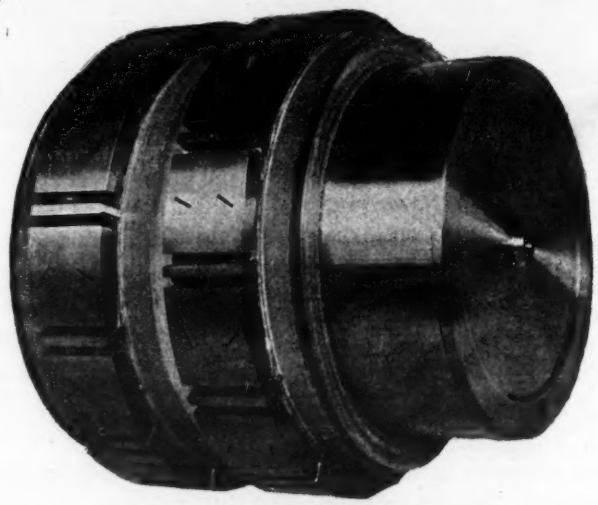
Two of these are located on the east side of the room, each driving a 75-kw two-phase Westinghouse alternator and a small direct current exciter, and there is a foundation for another unit of the same size. These are for the incandescent lighting and power service, and on the other side of the room are located the other two engines of the same size, devoted to direct-current arc-lighting service. This is supplied by three Westinghouse 75-light and one 100-light direct-current open-coil arc machines. There is also a reserve incandescent dynamo of 75-kw capacity on this side.

The method of driving these machines is one which, while not entirely new, is not yet very common, viz., the L. P. & D. transmitter, manufactured by the L. P. & D. Transmitter Company, of Montpelier, Vt., which is well illustrated in one of the accompanying engravings. One of the advantages which commended this device to the engineers was that it permitted of very close belt centres, two of the arc machines being belted on 4 foot 3 inch centres, and both of the incandescent machines on 6 foot 6 inch centres, which is certainly about as compact an arrangement as is possible where, on account of the smallness of the units, it is advisable to use belt transmission. Another illustration of its utility is shown in this station on the arc light side of the building. As before stated, this side of the room contains two 150-hp engines, from which are driven four arc-light machines, but it was the design to hold one of these machines and one of these engines as a reserve. To accomplish this and to add flexibility to the system, these engines are connected with either end of a jack shaft by means of jaw clutches, and the dynamos are driven from separate pulleys on this jack shaft by the L. P. & D. transmitters. The incandescent reserve unit is driven from the spare arc-engine unit. With this arrangement either engine may be thrown into connection with the shaft, and any one or all of the arc-light machines or the reserve incandescent machine, may be thrown either in or out of service without the aid of clutches, by simply changing the adjustment of the transmitter belt.

All of the engines are operated condensing, a single valve and a single eccentric controlling the steam of both cylinders. This is a great simplification over the usual valve gear of compound engines, and permits of their being operated non-condensing or condensing without any changes in the valves or their setting.

As regards lubrication, this is both copious and economical, being effected in the well-known manner peculiar to this make of engine by the churning action of the crank shaft and connecting rods, running at high speed in a closed reservoir of oil and water, the splash deluging every friction surface. The governor is also enclosed in a case which is filled with oil, so that the lubrication is both generous and automatic, and all wastes are prevented.

The incandescent lighting machines are of the well-known Westinghouse two-phase type, the armature being drum wound with connections taken out at four points 90° apart. The current is distributed at 2000 volts and 7200 alternations, supplying lights on the



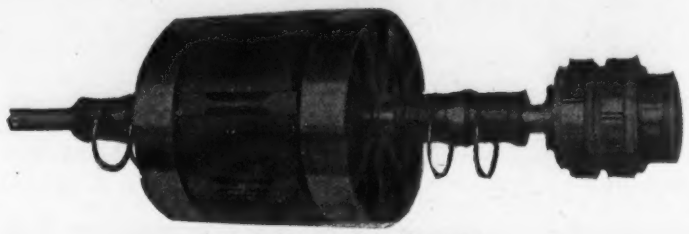
Commutator of Arc Dynamo.

single-phase alternating system and power on the two-phase system.

Returning now to the other side of the station the arc light machines are worthy of a passing word. These are of the constant current open coil type, but while really wound as two-phase machines are commutated so as to give an undirectional current. Instead of being self excited, as is usual with direct current arc machines, these are separately excited from a small exciter, which also does service when necessary in supplying the station lighting. This commutated two-phase current is slightly pulsating, but this is claimed as an advantage, as it causes a very slight but constant vibration in the moving mechanism of the arc lamps, which mate-

rially reduces the chances of sticking or failure to feed without perceptibly affecting the steadiness of the light.

As shown in the cut, the armature coils are entirely enclosed in the metal of the armature, so that it is effectually protected from possible mechanical injury. The stampings of which the core is built up have eight T-shaped teeth, upon which the armature coils, previously wound on forms, are mounted and held in place by wooden wedges dovetailed in. By the arrangement employed the



ARMATURE OF ARC DYNAMO.

replacing of a damaged coil is an exceedingly simple matter, and can be performed by an ordinary mechanic in a very short time.

A word also about the commutator and method of commutation may not be out of place at this time. As is usual with all open coil constant current machines relying upon their self induction to prevent disastrous cutting by sparking, the dead spaces between the commutator blocks are wide. In the earlier types of this machine these spaces ere either left vacant or were filled in with some solid insulating material. In the former case the brushes were apt to chatter, and in both cases they behaved badly with the tool when it was necessary to put them on the lathe to turn them down. A very simple and effective remedy for both troubles was found by introducing into this air gap an intermediate narrow block of copper, insulated of course both from the shaft and from the adjacent commutator segments. This arrangement is shown in the cut.

As to the method of commutation, there are in this machine eight armature poles and only six field poles, but by the method of commutation two of the armature coils are always dead, the connections of the coils being arranged according to the diagram herewith:

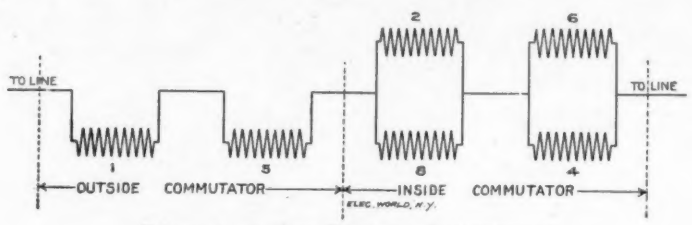


DIAGRAM OF ARC DYNAMO CONNECTIONS.

Coils 1 and 5 of the outside commutator are in series, and 3 and 7 dead, while 2 and 8 of the inside commutator are in multiple series with coils 4 and 6. To this commutator a two-phase current having 6600 periods per minute is delivered, and to the line a direct current of 6.8 amperes.

But the most interesting feature of this most interesting machine is its method of regulation. While Sayre in England and Ryan in this country have been trying to overcome or nullify armature reaction, the designers of this apparatus have taken the bull by the horns and converted it into a useful agent. By a bold step they have striven to magnify this armature reaction to the highest extent, and thereby have obtained a characteristic beyond the bend, which is essentially a vertical straight line which means exact regulation within wide limits solely by means of armature reaction. Then, in addition to this, by means of the unvarying field excitation, they have extended this regulation so that if the dynamo be absolutely short circuited, the rise of current is said not to exceed 1-10 ampere.

The switchboard needs no special mention, except that it is a handsome marble structure equipped with plunger switches for the alternating current, and operates the generators in multiple, except during light loads.

All of the steam piping in the establishment is extra heavy and provided with valves and fittings so as to be interchangeable, enabling any boiler to be put on any engine. The pipes, boilers, heater and purifier are covered with crimp asbestos paper furnished by the New York Air Cell Company, and thus are well protected against radiation losses.

In closing, it is worth while calling attention again to the very compact arrangement of this plant, which for a belted one with units of the size employed probably has never been excelled.

In the boiler room it was found that there was but 1.5 spare feet for each rated horse-power of steam generating plant, including all auxiliaries except stack. In the dynamo room the following figures obtain: Each 75-light arc machine occupies 4 feet x 5 feet 6 inches floor space. Each 75-kw unit, including the 150-hp engine, dynamo and transmission, covers a floor space of 10 feet 9 inches x 8 feet 6 inches, or 91.3 square feet = 1.2 square feet per kilowatt, and the dynamo room as a whole, including engines, dynamos, transmissions, switchboard and all accessories as well as ample clearance space, is on a basis of but 2.6 square feet per indicated horse-power.

Walker Company Owned by Four Men.

As mentioned in the last issue of THE ELECTRICAL WORLD, the entire capital stock of the Walker Company has passed into the hands of four men. All the stock and bonds of the company, there being $2,500,000 of the former, and $1,500,000 of the latter, have been bought, in four equal parts, by ex-Gov. Roswell P. Flower, Major J. W. Hinkley, and Messrs. Anthony N. Brady and Perry Belmont, all of New York. The largest interest purchased was that of Mr. J. B. Perkins, of Cleveland, who was formerly the chief holder of the stock and bonds. The stock of Mr. Sidney H. Short was also transferred, although Mr. Short retains the position of vice-president and electrician of the company, the other officers being the Hon. J. W. Hinkley, president, and Mr. F. W. Ferguson, treasurer. There is no secretary.

The new owners are well-known financiers with large interests in the industries built up by the rapid modern progress of the mechanical arts. Ex-Gov. Roswell P. Flower is a prominent figure in many of the recent electrical developments. He has taken particularly a deep interest in the utilization of electricity for the propulsion of boats on the Erie Canal. Mr. Brady is also well known in electrical circles. He is sometimes spoken of as a "Trolley King," owing to his large investments in the street railway systems of Brooklyn, Albany and other cities. Mr. Belmont is a member of the prominent banking house of August Belmont & Co., with close business connections with the other leading financial houses of the world.

The Walker Manufacturing Company was organized in 1883, to carry on a general foundry and machine shop business, and more particularly to manufacture cotton presses and the cable winding mechanism used for cable railways. Many of the largest equipments of such machinery were supplied by the company. In 1893 it became evident that the cable system was to be superseded by the electric tramway systems, and the Walker Manufacturing Company determined, therefore, to manufacture dynamos and motors for railway and lighting purposes. Electrical engineers of the highest skill and ability were obtained to design an entirely new line of apparatus, with the result that in the course of three years the great plant in Cleveland was almost entirely employed in the production of electrical apparatus; general machine construction, formerly the chief factor in the business, being a mere trifle in comparison with the newly developed electrical work. The designs of the company's appartus are largely covered by the patents of Mr. Short, who has been the leading spirit in the technical departments of the company's work.

In 1896 the Walker Manufacturing Company and the Consolidated and Electrical Construction Company, of New York, were combined into the organization knowwn as the Walker Company, incorporated under the laws of the State of New Jersey. The Consolidated and Electrical Construction Company had been for some time engaged in the manufacture of electrical apparatus in the city of New Haven, Conn. Its factories are at present used by the Walker Company for the building of the smaller detail and subsidiary apparatus.

The Next Meeting of the National Electric Light Association.

A meeting of the executive committee of the National Electric Light Association was held at the Holland House, New York, Monday evening, November 22. There were present President Insull, Messrs. George R. Stetson, F. A. Gilbert, John A. Seely, W. McLea Walbank, George A. Redman, A. J. DeCamp, E. H. Stevens, W. W. Bean, George Urban, and ex-Presidents James I. Ayer and E. A. Armstrong. It was voted to hold the twenty-first convention of the association in Chicago, Ill., in 1898. The exact date of the meeting, which is to be in May or June, will be fixed by the president.

The Lighting and Power Stations of the Richmond Railway & Electric Company.

The plant of the Richmond Railway and Electric Company, at Richmond, Va., possesses much interest as an example of the evolution of central station practice during the last fifteen years. The company is a consolidation of several that have started from time to time, and the apparatus now in use in its stations is a necessarily heterogeneous collection inherited from the various plants that are amalgamated under its control.

The company operates all the electric lights in Richmond and its vicinity and a large electric railway system, aggregating about 120 cars on over 60 miles of tracks. Included in the railway system is the original Sprague line—the Richmond Union Passenger Railway. While all the old Sprague motors have found their way to the scrap pile or are degraded to driving repair shop machines, some of the original dynamos and one of the engines of that early installation are still in service. The useful survival of some of these crude and ancient types is a very remarkable indication of the thorough character of the work that was done while the electric railway and the central station for lighting were both in a formative stage.

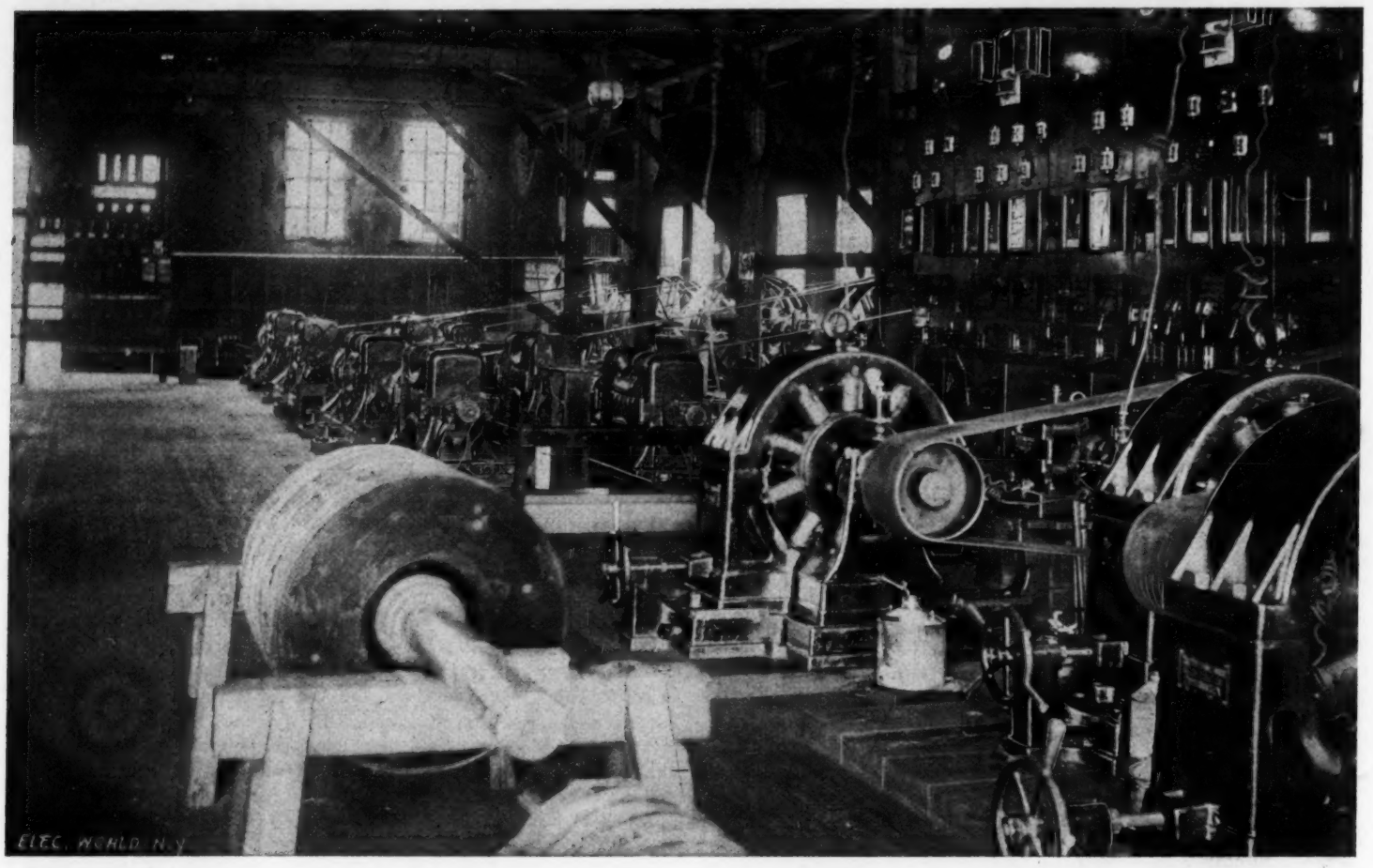
The plant is situated on two small islands in the James River, opposite the central portion of the city. The lighting station occupies Johnson's Island, the railway power plant being on Brown's Island, famous as the site of the Confederate arsenal which exploded with calamitous results in the great fire following the siege of the city in 1865. The current of the river at this point is very rapid, and originally, the two islands consisted mainly of outcrops of the hard granite of the river bed washed bare by the swift stream and an occasional freshet. Sea-walls of stone have been constructed, however, and the ashes and cinders from the boilers filled in behind them, thus extending the area of the islands. Both are connected with the mainland by short and substantial bridges.

The station on Johnson's Island is contained in two buildings of frame construction, with tin roofs and corrugated iron sides. The boiler house is 120 x 60 feet and has retaining walls on two sides, and contains five boilers of various vertical water-tube and "hedgehog" types, aggregating 2200 horse-power. Coal is hauled to both the islands in carts, no system of direct delivery being practicable

In the dynamo house, which is 100 feet square, and of the same frame and sheet metal construction as the boiler house, there is a collection of generators for arc and incandescent lighting and power of a most interesting nature. Much of this machinery has been in use since the early days of electric lighting, while some of it is modern and in all respects up to date.

The arc service is maintained by seven Wood 80-light machines, of which four furnish 6.8 amperes and three furnish 10 amperes, and six Schuyler machines of 45 lights capacity each, giving 6.8 amperes current. The Schuyler regulators, consisting of variable water rheostats in shunt with the fields, are still used, but in practice are helped out with hand regulation, the arcs being grouped in rather large numbers on each circuit.

All these machines, as well as the incandescent and power machines, are belted to countershafts carrying clutch pulleys. The engines are three in number, consisting of one 17 and 33 x 48-inch tandem compound Greene Corliss; one 20 and 36 x 48-inch cross compound Wheelock, and one 13 x 14-inch Armington & Sims engine. This latter engine furnished motive power for the original Sprague railway plant in 1887.



The Eastern Side of the Lighting Dynamo Room.

The incandescent circuits are fed from five Westinghouse smooth-core alternators, of which three are of 1650, one of 1500, and one of 2650 lights capacity, all working at 1000 volts and a frequency of 16,000 per minute.

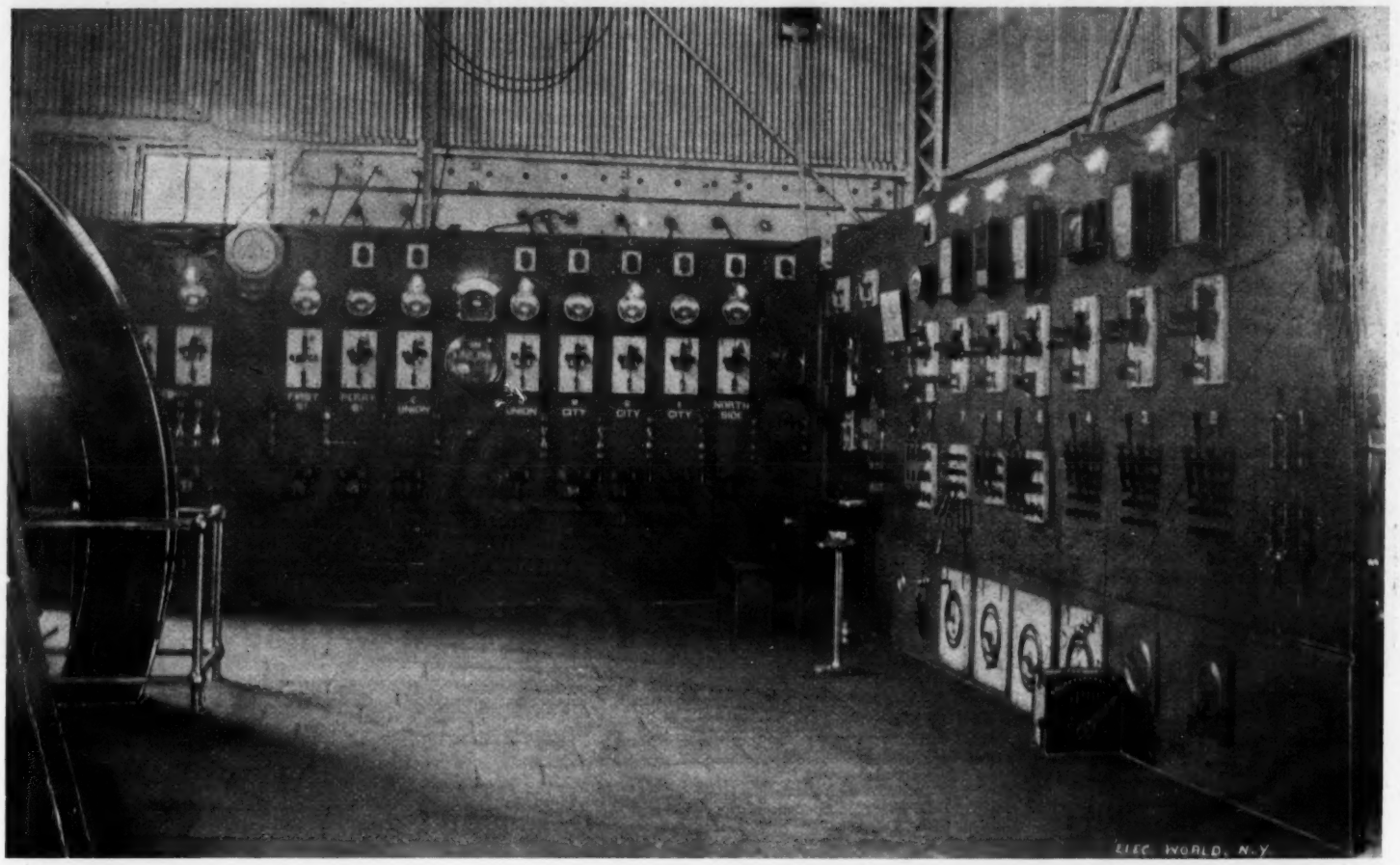
Power for commercial service is furnished at 500 and 250 volts direct current, three-wire system, from a curious collection of small dynamos, some of them survivals of older days. Three Edison bi-polar machines of 40 kilowatts each, one of 20 kilowatts, one C & C bi-polar of 35 kilowatts, one 50-kw bi-polar Westinghouse machine and one 120-kw multipolar dynamo of the same make, complete the outfit for this service.

The switchboards are four in number, the two arc boards being of the types furnished ten or twelve years ago. They are built up on wooden strips, the usual jack-plug and cable switching arrangements being used. The incandescent circuits are controlled from a switchboard of the standard Westinghouse type on slate panels. Twenty-one circuits are handled. The pressure on the line to Westbrook, a country place seven miles away, is stepped up to 2000 volts by two Westinghouse transformers of 12.5 kilowatts each.

IN THE STORAGE BATTERY SUB-STATION.

system and about half a mile from the station. Here, in a brick building of two stories height, is being installed a battery of 150 chloride cells of 2000 ampere hours capacity each. It is proposed to feed this from a 250-volt generator at the station, and to replace the present single-phase alternating distribution in a district about three-quarters of a mile square, comprising the business centre, with a three-wire system. The fact that the municipal government may soon require the placing of the lighting circuits underground through this district has probably also influenced the company to make the change to direct current at low pressure.

The receiving and distributing switchboards at the sub-station are not yet in place. They will be of the most modern type, and will contain the field rheostats for the generators at the power house, half a mile away. Hand control through their agency is contemplated, ammeters in the receiving and discharging circuits furnishing the necessary indications.



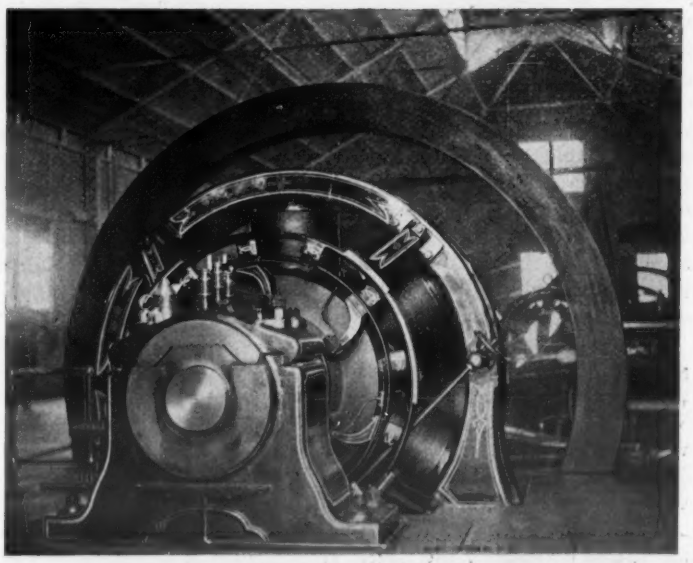
THE RAILWAY SWITCHBOARD.

The power switchboard is of slate, the panels being set in an iron frame. Its capacity is 200 amperes on each side of the 500-250 volt three-wire distribution for this purpose.

The arc circuits are of weatherproof wire of Nos. 6 and 8 gauge, and comprise a total of 687,000 feet, supplying 1019 open arc lamps. The street lighting, which absorbs about 65 per cent. of the arc output, is worked on the all-night and every-night system.

The incandescent circuits are all of weatherproof wire and aggregate 350,000 feet in length. At present there are connected 227 transformers, averaging about 30 lights capacity each, the smallest being of 10 lights capacity and the largest of 5 kilowatts. Almost every make is represented among them. Meters to the number of 137 are in service, and the total number of incandescent lights connected is about 6000. All the lines are aerial, there being in use 2400 poles averaging 40 feet in length. The street arcs are generally suspended from mast arms or placed on the top of the poles. The great majority of the lamps are of the Schuyler pattern, the regulation being effected by a detent on the fastest wheel of a train of wheels driven by the weight of the upper carbon and rod through a rack on the latter. Their regulation is excellent.

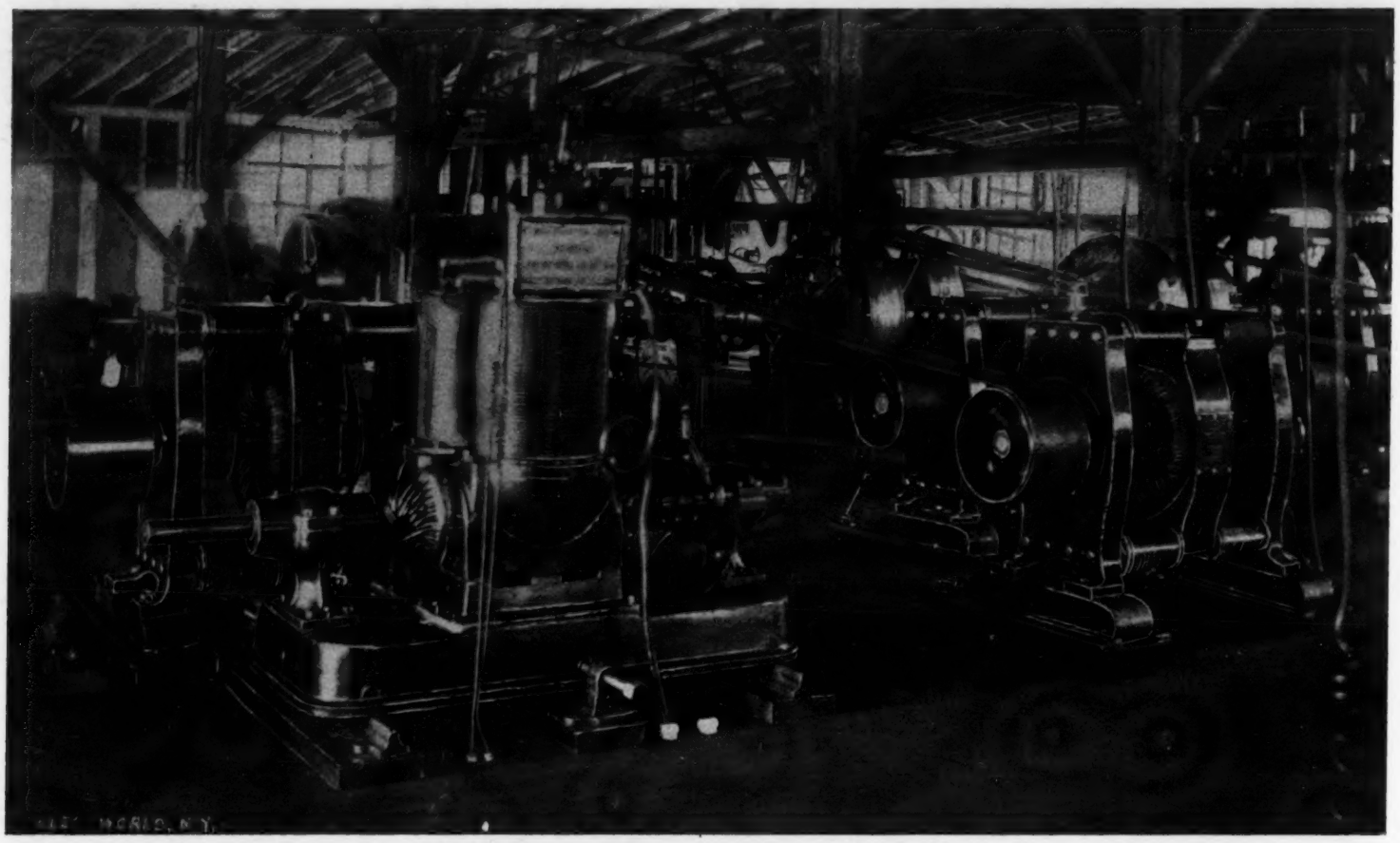
To replace the rather wasteful installation for incandescent lighting, a storage battery sub-station is now being installed at Seventh and Franklin Streets, near the centre of distribution for the lighting



ONE OF THE RAILWAY GENERATING UNITS.

The railway plant on Brown's Island is quite similar to the electric light plant, in that it consists of a heterogeneous collection of machinery which has been added to it from time to time as the necessities of the service demanded. The buildings consist of a dynamo house 60 x 100 feet, and a boiler house 50 x 110 feet. These buildings have corrugated iron siding and a plank and tin roof, all laid on steel frames. The dynamo house is floored with slate laid on 3-inch oak planks supported by steel joists. The floor of the boiler house is paved and a masonry retaining wall is built on two sides of yards from the building. Return conductors are brought in over one of the bridges to the island, the main feeders going out on a heavy line of poles. As is the case universally with wires in Richmond, the feeders for the railway system are overhead and consist, for the most part, of stranded cable of large size with weatherproof insulation. The tracks of the company's railway system have recently been overhauled, and are now mostly of 8-inch deep girder rail laid in gravel ballast.

The performance of the two stations, briefly described above, is



The Western Side of the Lighting Dynamo Room.

this structure. On this island are also the general executive offices of the plant and a work shop and repair shop.

The boiler house contains nine boilers, as follows: one Babcock & Wilcox of 208 horse-power; one Campbell & Zell of 270 horse-power; one horizontal tubular boiler of 66 inches x 16 feet; three boilers of the same type, 60 inches x 16 feet each, and three of 72 inches x 16 feet. There are seven engines, as follows: one 16 and 30 x 48-inch Wetherill tandem compound; one 18 x 36-inch Greene engine; one 17 x 36-inch and one 16 x 36-inch Greene engine, and two Armington & Sims engines, each 14 x 14. There is a Westinghouse 14 and 24 x 14-inch compound, which is not at present in use. All of these engines, with the exception of the large Wetherill compound, are belted to dynamos. They are worked condensing, three Worthington condensers and pumps being used.

The generators consist of one General Electric eight-pole machine of 300 kilowatts direct connected to the Wetherill engine, and the following machines belted to the various engines; one Westinghouse 250-hp multipolar; three Westinghouse machines of 150 horse-power each and two Westinghouse machines of an early two-pole design, resembling the old Siemens dynamos, of 75 kilowatts each.

The switchboard is of slate on an iron frame, and contains eight generator panels and thirteen feeder panels. In addition to these there are two wattmeter panels and a set of switches for the boosters. These boosters are constructed of four of the old dynamos which were used with the original Sprague Street Railroad installation in Richmond. Each booster consists of an Edison 45-kw machine, direct coupled to a similar 60-kw machine, the latter operating as a motor. The smaller machines have been rewound as series generators, and current for the Seven Pines branch is fed through them. They raise the pressure 180 volts on a load of 200 amperes. The centre of distribution of the railway system is at some distance from the power plant, and the nearest point of the tracks is about 300 remarkably good, when it is considered that they are in no sense representative of modern practice. Coal is delivered to the two plants at the rate of $2.20 a ton for bituminous lump coal and $1.05 for bituminous slack. A mixture of about two parts of the latter to one of the former is used under the boilers. Notwithstanding the crudity of these stations in some respects the company has prospered, and the service which it gives is of an excellent order. Great credit is due to the superintendent, Mr. E. H. Trafford, for many ingenious solutions of the difficulties presented to him by the conditions of electric lighting in Richmond.

Western Union Suit Against the Government.

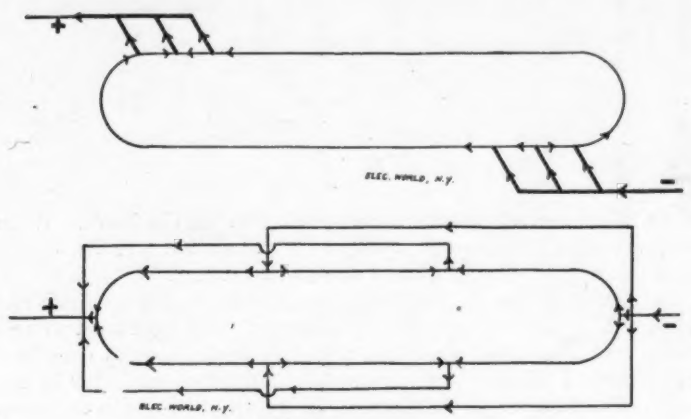
The Court of Claims on November 22 rendered a decision in the case of the Western Union Telegraph Company, which protested throughout the administration of Postmaster-General Wanamaker against the order fixing the rate to be paid by the Government for the transmission of telegraphic messages at 1 mill a word. At the close of Mr. Wanamaker's term of office the Western Union Telegraph Company sued the Government in the Court of Claims to recover the amount of money to which it thought it was entitled for the business transacted during the existence of the order. The matter was referred last June to First Assistant Postmaster-General Heath, as master, for examination. In September last he reported that the telegraph company was entitled to recover $258,869.84. This report was confirmed by the Court of Claims, as above stated, and judgment for that sum given to the telegraph company. The decree expressly stipulates, however, that nothing in it shall in any manner prejudice the right of the Government in case of any other litigation respecting telegraph rates, to assert its right to fix the rates for Government business.

Setting Up Large Generators.

BY GEORGE T. HANCHETT.

The installation of a simple bi-polar machine, the bearings of which are all aligned, is a very simple matter, but the day for such machines has to a great extent passed away, and the modern dynamo, both for isolated and power work, is of the direct connected multipolar type. To set one of these machines up and get it to run in a satisfactory manner is by no means a simple piece of work. Of two machines identical in construction and size and apparent smoothness of running one may operate to perfection, while the other will spark at the commutator, get very hot at low loads, and be so thoroughly unsatisfactory that something will have to be done to remedy the difficulty.

The multipolar dynamo is liable to a number of faults which are not found in bi-polar machines, and, as literature on the subject of



FIGS. 1 AND 2.

faults has been mostly confined to the latter type, the faults of multipolar machines are generally known only by those who have actually had to contend with them.

There are two popular windings which are used in multipolar construction on drum armatures, and it may be said in passing that most modern machines have drum windings. These are known technically as the wave winding and the lap winding, but in more common parlance as the series and parallel windings. In the series windings there are but two circuits in the entire armature, although these circuits may be fed at numerous points by as many brushes. Fig. 1 illustrates in diagram how a number of brushes can feed a two-circuit winding. The closed loop represents the armature circuit, and the brushes are bunched together at opposite ends of the loop.

With a parallel winding there are as many circuits as brushes, and the latter are distributed at equal intervals of resistance about the armature circuit, as shown in Fig. 2. The brushes are connected in parallel by the outside connections. These various circuits of the armature work in parallel and, like dynamos working in parallel, they must all have the same voltage or one section will carry more current than its mates, or will feed current to the section of low voltage, causing it to drive the armature in the same direction as a motor. This latter action is called bucking, and is attended by heavy sparking at the commutator, often appearing first at one brush and then at another, for the action of two sections is such as to cause them to exchange functions with increasing rapidity.

The reaction of the motor parts of the armature tends to strengthen their field, while the reverse is the case with the dynamo parts. This causes the exchange just mentioned. It is therefore easily possible for the armature to carry immense currents within itself, while delivering very light loads to the line. The causes of unequal action in such armatures as these are numerous.

If the field poles are not of the same strength, or if the field magnets are not truly concentric with the armature, one or more of the circuits will receive a higher magnetization than the other and will generate more voltage. It can be definitely decided as to whether one section of the armature is doing more work than the others by interposing an ammeter into the brush circuit feeding that section. Such an arrangement of instruments is shown in Fig. 3, the instrument being so connected as to measure all of the current which one of the brushes is suppling or receiving. Of course each brush should carry an equal amount and an inequality announces unbalanced armature circuits, while a fluctuation, the external load being constant, or the presence of a current at no load with separate excitation, shows a tendency to bucking. When either of these faults has been definitely determined to exist the first thing that should be done is to stop the machines, separately excite the fields, take and record the terminal voltage of each spool, and compare the results for equality. If the spools are of equal resistance, and wound with the same size wire, it is probable that they each have the same number of turns, and as they of necessity carry the same current, being connected in series they must be equal in magnetizing effect.

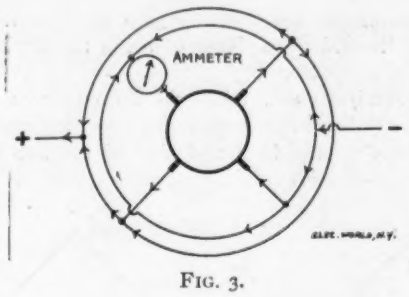


FIG. 3.

If the series coils are in series their separate effects on the armature voltage will probably be equal, but if they are connected in parallel this by no means follows, for the current in all probability will not divide equally between them, it being a most difficult thing to make a number of very low resistances exactly equal.

If the trouble lies in the series coils, it will be evident in the greatest degree when the load is heavy and will entirely disappear when the machine is running at full voltage, but supplying no current. If on the other hand the machine gets hot and flashes and sparks at the brushes when no current is taken from the terminals, it is pretty certain that one of the shunt coils is out of order, or that the field magnet is not properly aligned with reference to the armature. A defective shunt-field spool will be of lower resistance than its mates, as a usual thing, although mistakes have been made in

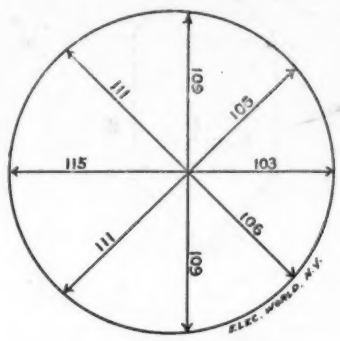


FIG. 4.

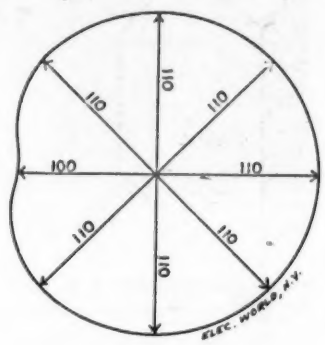


FIG. 5.

winding a spool with a wire that was too small, in which case the opposite would be true. A difference in the resistance of one of the spools should stamp it as defective, for the reason that all should measure up the same. Troubles with the winding are usually corrected in the winding room, and there is no convenient expedient to use for them in the power house, but troubles with the alignment of the machine must be corrected when the machine is being installed.

The modern direct-connected machine usually requires that its field be aligned on the engine bed, and this is frequently done by means of a taper gauge, the clearance of each pole piece with reference to the armature being made equal. This usually but not invariably produces desirable results. It will be found much more satisfactory to proceed as follows: Set up the machine, omit the connections from brush to brush, then align it as nearly as possible by means of the taper gauge and bolt it firmly down to the foundation. Then separately excite the field, start up the machine, and take the voltages between the various brush studs, comparing them for equality. They are to be considered as so many dynamos to be connected in parallel, and the voltage of each should of course be adjusted to the same amount before this can be safely done.

If the differences of potential, plotted around a point at equal angular distances, form a symmetrical figure, as shown in Fig. 4, the trouble is due entirely to lack of alignment, but if the figure is of a distorted nature, such as is shown in Fig. 5, it is probable that one of the pole pieces or the coil it carries is at fault. In the former case the pair of brushes between which too high a voltage exists, indicates that the pole piece which has generated that voltage is too

near the armature and that the field magnet should be shifted to the proper position, either by blocking up its foundation lugs, or moving the field frame laterally until equal voltage is found to exist between all the brush studs. Some precaution must be observed in doing this. The machine should be stopped, the field magnet demagnetized, the adjustment made, and the field magnet should be securely bolted down before a second trial is attempted. Any attempt to adjust the field magnets with reference to the armature when they are magnetized, or when the machine is running, is certain to result in disaster, for the field if out of balance and released from its foundation will immediately grip the armature so tightly as to either tear its surface to pieces or bring the engine to a standstill.

This alternate adjustment, trial and readjustment is a tedious process, but it only has to be performed once, for after it has been done, the position on the base and also of the two halves of the

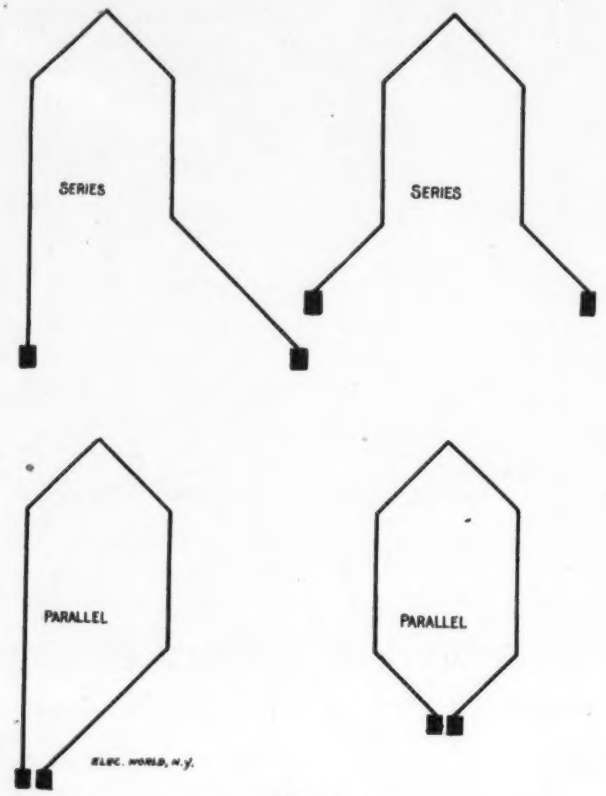


Fig. 6.

field magnet, with reference to each other, can be marked in two places with a cold chisel which indents the surface of both members across the dividing line.

If, when testing the dynamo in the way just outlined, a fluctuating voltage is found, one that rises and falls a few volts, in step with the revolutions of the armature, the latter is probably out of true. This may or may not be a serious defect.

If the engine bearing is loose the thrust of the connecting rod may sway the armature back and forth in its field and the obvious remedy,of course, is to take up the play. This is particularly liable to be the case with overhung armatures which have no out board bearing on the shaft. If the hub is secured by a taper-driven key it may be that it is forced to one side by the latter, thus causing an eccentricity. Locating the trouble by a chalk mark on the armature and comparing the position of this mark with that of the key will quickly determine whether the trouble may be accounted for in this way. Sometimes the shaft is sprung out of true and it will be necessary to determine which member is at fault. Aside from mechanical considerations the location of the fault places the responsibility on either the dynamo or the engine builder.

If the armature can be grasped in two or more places about the shaft, and is perfectly true, shifting it about the shaft will alter the angular position of the chalk mark obtained by holding the chalk against the revolving armature. If the armature itself is out of true the position of the chalk mark will not be changed by this process; an amount of eccentricity that could be endured from a mechanical standpoint might be entirely inadmissible from a magnetic one.

With the series winding a defect which would cause an interchange of currents in the armature circuits would have to exist in the armature itself, for unsymmetrical magnetization would affect both circuits alike. Series windings will be most often encountered on machines of high voltage, 500 or more, while parallel windings will most often be found in isolated plants where the voltage does not exceed 120.

It may be important to determine whether the winding is on the series or parallel plan, in order that the fault may be located. This is not always easy even for the expert, and it is especially trouble-

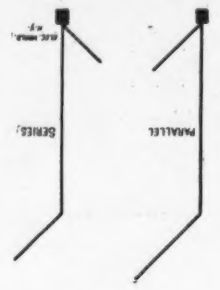


Fig. 7.

some when the windings are concealed with canvas heads. When they are open it is a comparatively easy matter, but a review of just how this may be done will be of assistance to many.

In Fig. 6 are shown four coils; the upper two are on the series plan, and the lower two on the parallel plan. The right hand column has a lead of one-half the pitch, and it is always easy to determine the character of such a winding. Select the top conductor in any slot and if the ends go in opposite directions, as shown in the upper right hand figure, it is a series winding, while if they go in the same direction, as shon in the lower right hand figure, it is a parallel wnding. If the coils are given no lead, as is shown in the left hand column, the series and parallel windings are alike in this respect, and a different method will have to be employed, which wil be better understood by consulting Fig. 7. Take the top conductor in one of the slots, note in which direction the conductor, which is soldered

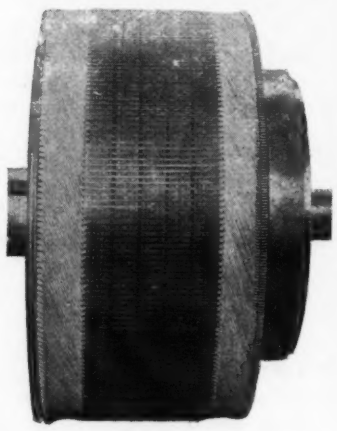


Fig. 8.

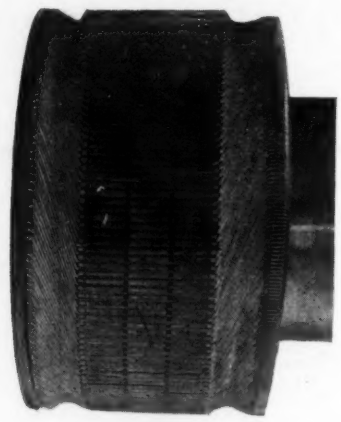


Fig. 9.

into the same commutator bar, proceeds, and if that is in the same direction as the way this top conductor bends on the back of the armature, as shown in the left of Fig. 7, the winding is parallel. If it is in the opposite direction, as shown at the right, the winding is series.

In a complete series wound armature the outside end connectors slope in the same direction, as shown in Fig. 8, and if the armature is parallel wound they slope toward each other, as shown in Fig. 9. If the heads of the armature are covered with canvas so that the direction of the connections cannot be determined, place a single pair of adjacent brushes in the machine and pass a small current through them. Connect one terminal of a low-reading voltmeter to one of the brushes, and take and record the voltage of supply. Then measure the voltage at the commutator at the points where the other brushes would touch it.

If a result is obtained, such as is shown in Fig. 10, the winding is series, but if a result is found, such is is shown in Fig. 11, the winding is parallel. As a rule the commutators of parallel wound arma-

tures are longer than those of series-wound armatures carrying conductors of the same size. Narrow commutators and series windings go together.

Series windings are sometimes sandwiched, that is two independent series windings are placed on the armature and connected in multiple by brushes that are broad enough to bridge several commutator segments. Alternate bars in a commutator are connected to a single winding. One winding may be at fault, either by partial ground or a poorly soldered contact, while the other may be perfect. This may cause the two windings to be unequally loaded and the good winding carrying the heavier load is liable to have its commutator bars burned, resulting in the bars being alternately black and clear, a very puzzling effect to the uninitiated.

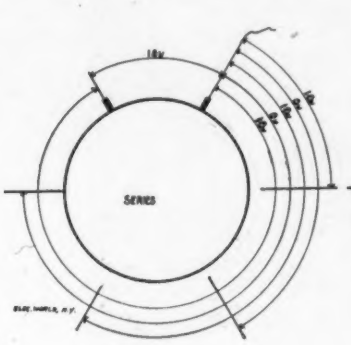


FIG. 10.

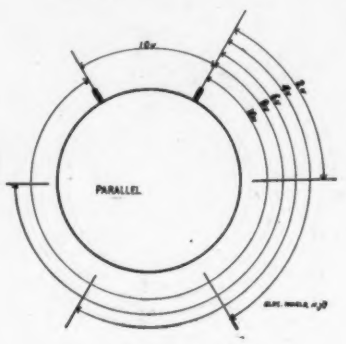


FIG. 11

If the fault is of an intermittent nature and acts only when the drag of the pole pieces on the armature conductors emphasizes it the result will be a zone of alternate black and clear bars equal in angular measure of the width of the polar faces, and a zone of clear bars similarly equal to the distance between the pole tips.

These alternate striped and clear zones appear all the way around the commutator. This most puzzling appearance has actually occurred in numerous instances.

If two adjacent bars of a commutator become burned and there is no similar appearance in another position, it is probably due to a defective connection on a coil in a parallel winding. If there are as many burned spots as poles equally spaced about the commutator, it indicates a similar defect in a series winding. Either of these troubles make the armature a candidate for the winding room.

Power Distribution in the Kootenay.

The famous Kootenay copper and gold mining district in British Columbia is seriously hampered by the cost of power, the only available fuel being wood, and the forests in the neighborhood of the district itself have already become almost depleted. To supply cheaper power a large electrical generating plant is being installed when the Pend d'Oreille River empties into the Columbia River. Here a fall of 200 feet is available by means of a short flume, with a sufficient body of water to generate many thousand horse-power, the annual variation in flow being small, owing to the enormous storage capacity of the large lake, Pend d'Oreille. An old placer-mining plant, with about 1000 horse-power of water wheels in place, is being converted by the Pend d'Oreille Water & Light Company into an electrical generating station. To this will be added 3000 horse-power more, the whole being distributed to the mines round about, to be used for mining machinery and the electrolytic refining of copper. The plant will be situated in almost the centre of the mining district, and distribution lines will radiate in every direction. The longest line contemplated at present in some 22 miles in length.

Electricity in Hawaii.

According to statistics prepared at Honolulu, Hawaii, covering the year 1896, there were imported into the Hawaiian Islands electric and telephone instruments and materials of a total value of $32,492.04. Of this, $13,099.89 represented the value of the goods on which duty was paid when imported, and $19,392.15 the value of the goods entered free. In addition to this there were also entered free under the provisions of the civil code of the islands, electric wire, valued at $731.09, and other articles and material, to the value of $4,306.13.

The Enlargement of the Niagara-Buffalo Transmission Line.

The increased demand for Niagara Falls power in Buffalo has necessitated the installation of more copper on the transmission line carrying power from the Niagara Falls Power Company's plant, at Niagara, to the ponts of distribution in Buffalo.

On the pole line which was described in THE ELECTRICAL WORLD of June 19, 1897, there have been placed three new wires of 350,000 circular mils each. All six wires are placed on a six-pin cross arm, the two circuits being symmetrically placed on opposite sides of the pole. The wire is transposed five times between terminals, the transposition being effected by the aid of a second cross arm and a simple spiralling. The wire is supported on triple petticoat type "C" Imperial insulators, the same as those which have given perfect satisfaction on the original wires. The wire was made by the American Electrical Works, and is built up of nineteen strands, the weight per mile being 5600 pounds. The new wire was raised without turning off the current from the old line, which is operated at 11,000 volts. Special care was necessary when the woodwork was wet and rollers were placed on the cross arms, so that in hauling the wire over the arms there would be no tendency to disturb the line already in place.

The underground section within the city of Buffalo has been laid with cable made by the General Electric Company. The insulation is of the best quality of rubber compound, 9-32 of an inch in thickness, and the three lines instead of being in separate lead sheathings, are laid up together and covered with one lead sheath, the outside diameter of the whole being 2⅝ inches. This is then drawn into 3-inch ducts of tile made by the H. B. Camp Company. This avoids the inductive effect and consequent loss of energy in the metallic sheathing of the single-covered cables, but increases somewhat the difficulty of making proper joints. The cable now in use has given no trouble at all on the straight work, but it has been found somewhat difficult to make all the joints sufficiently perfect and dry to prevent an occasional breakdown. The new line was erected by the J. G. White Company, who built the original line.

The three transformers used to step-up the two-phase current, as supplied by the generators at 2200 volts to three-phase current at 11,000 volts, will be augmented by seven new transformers of the same size, made by the General Electric Company. Each of the ten transformers has a capacity of 1250 horse-power, giving a total step-up transforming capacity of 12,500 horse-power. These transformers are of the air-blast type and will stand in rows of four upon the air-pressure chamber whence the air is forced through the ventilating spaces in the transformers. It is intended to eventually raise the line pressure to 22,000 volts in place of the present 11,000. At the Buffalo end of the line new step-down transformers will be installed by the Cataract Power and Conduit Company to reduce the pressure to various voltages for distribution over the city network for motor uses. Several step-down transformers will also be placed in the station of the Buffalo General Electric Company to supply current to rotary converters, from which direct current will be taken for lighting and small motor service.

The Buffalo Railway Company is also increasing its step-down transformer and rotary-converter capacity in the Niagara power house. Three additional step-down voltage transformers are being installed in the transformer house between the station and the canal. These will be similar to the three already in use, each of 275-kw capacity, and stepping the current down from 10,500 volts to 375 volts three phase, for delivery to the alternating current side of the rotaries. In addition to the two 500-hp rotary converters already in operation there will be added two others of smaller capacity and construction, made by the General Electric Company. These will bring the total converter capacity in the station up to 2000 horse-power.

For further distribution in the city of Buffalo 45,000 feet of paper insulated cable has been supplied by the National Conduit and Cable Company. This cable is three-conductor, lead covered, with insulation seven thirty-seconds of an inch in thickness. Before leaving the factory it was all tested to a pressure of 25,000 volts alternating.

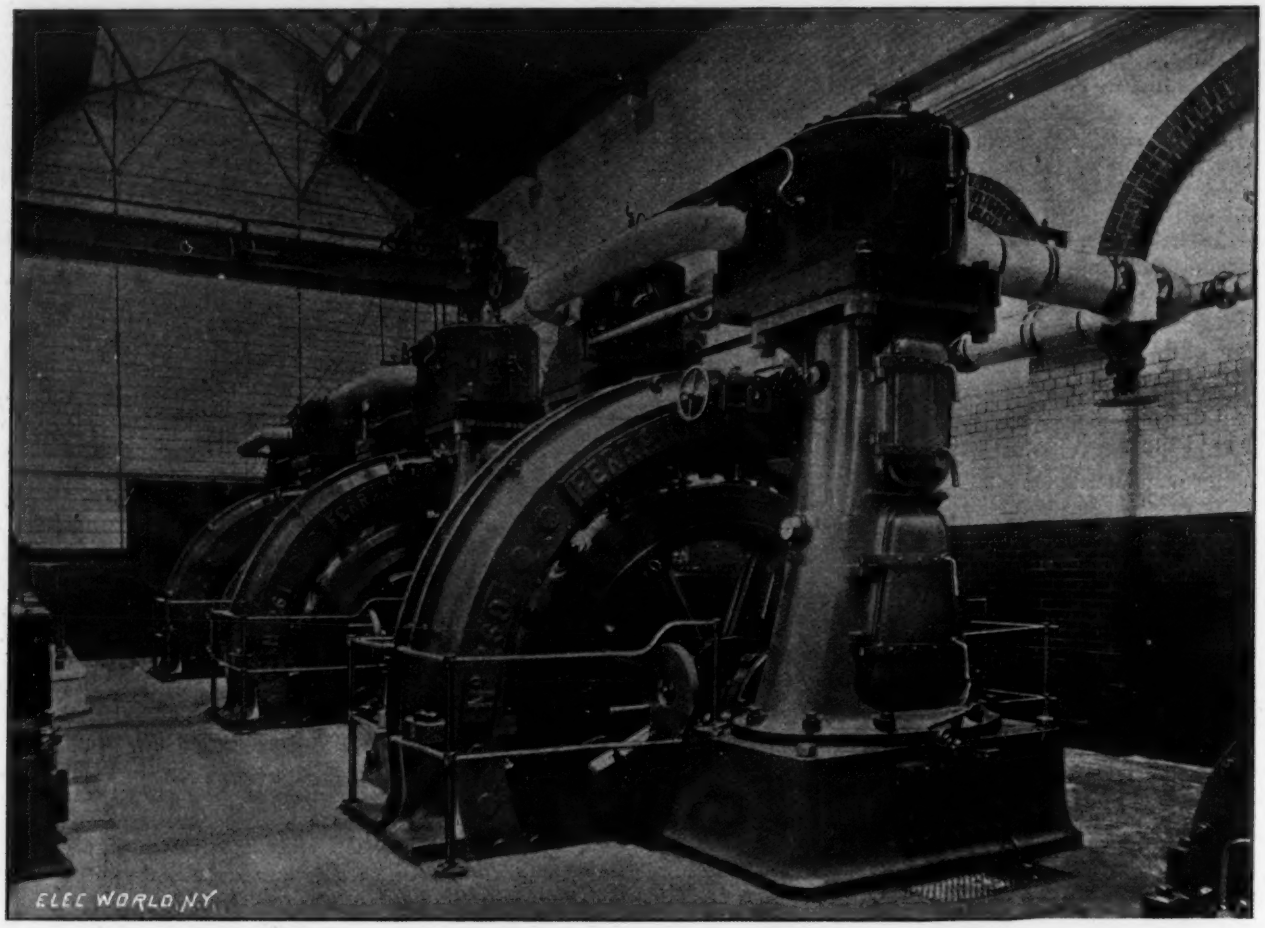
English and American Arc Light Stations.

According to our well-informed contemporary, the London *Electrician*, the number of English stations boasting of a load of over 100 public arc lamps is extremely limited.

A Modern English Central Station.

In common with central station practice in this country, the English practice is favoring more and more the increased size of generating units and the direct coupling of engines and dynamos. English stations, however, differ from American standards in some quite important particulars, chief of which are the use of rectifiers and the construction of dynamos and engines.

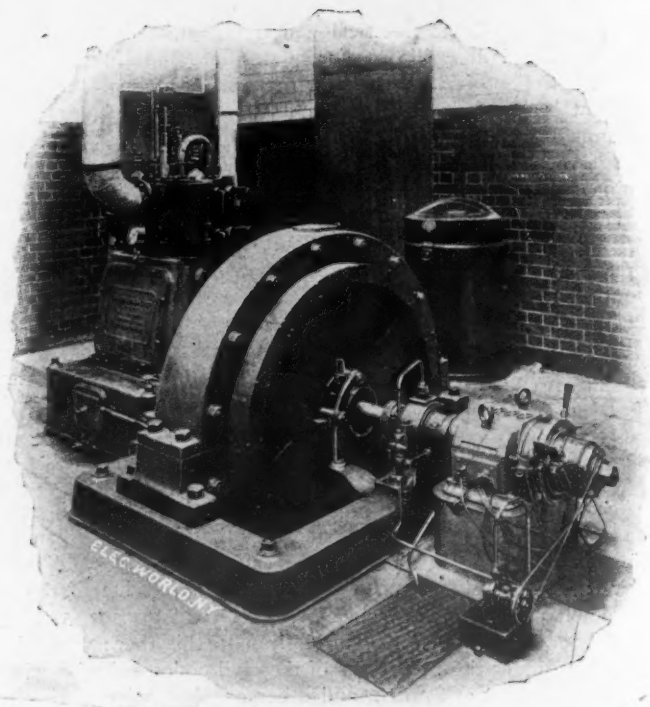
The Hammersmith Vestry Electric Lighting Works illustrates these resemblances and differences so well that the description in a recent number of the *Electrical Review*, of London, is well worthy of reproduction in these columns. This new station is designed to transmit current on the high pressure alternating system at a pressure of 2000 volts, the local distribution being at a pressure of 110 volts, on mains supplied by underground sub-stations.



Engine Dynamos in the Hammersmith Station.

The boiler plant of the central station consists of two Babcock & Wilcox water tube boilers, with super-heaters, one Lancashire boiler, one economizer and the feed pumps. The Babcock & Wilcox boilers are rated at 250 horse-power each. Each has a heating surface of 2437 square feet, and a grate area of 44 square feet. The Lancashire boiler is 28 feet long by 7 feet 6 inches in diameter, built of mild steel, and with two flue tubes, each 3 feet in diameter. This boiler, which is intended to carry the day load, is rated at 200 horse-power. Space is provided for a third Babcock & Wilcox boiler. The economizer is of the well-known Green type, using the flue gases to heat the feed water. It is built up of 144 tubes, 9 feet long by 4½ inches in diameter, with soot-cleaning scrapers run by an electric motor. Duplicate feed pumps of the Worthington make are provided, each with 4000 gallons capacity per hour, either one being capable of supplying the whole boiler plant with feed water. The feed pipes are so arranged that any or all the boilers can be supplied with either hot or cold water, no failure of any one part of the feed-water system interfering with the supply of any of the boilers.

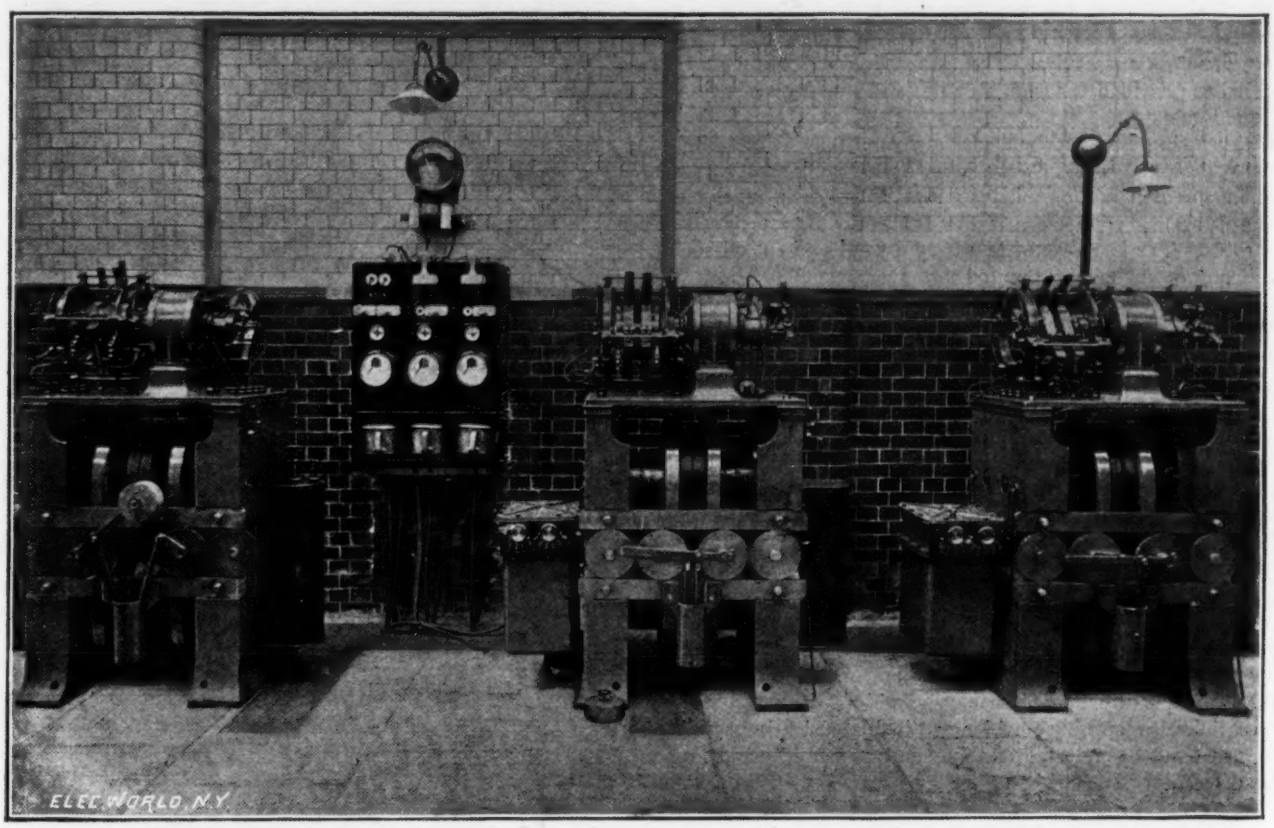
The main steam pipes running to the engines are arranged on the ring system, with valves so placed that the failure of any section will only shut down one engine or one boiler. The diameter of the main steam pipe is 7 inches. Between each boiler and the steam main is a check valve, which prevents steam backing up into an idle boiler. The exhaust pipe, 12 inches in diameter, is carried overhead in the engine room. It is provided with an automatic atmospheric release valve, and is carried to an evaporative condenser. This condenser is placed in the open air, and consists of a series of corrugated cast-iron pipes over which cooling water is pumped, the evaporation of this water condensing the steam inside the pipes. There are 160 of these pipes, each 5 feet long, which gives a condensing capacity of 400 horse-power. Beneath the condenser there is fixed a 4000 gallon storage tank, which catches the cooling water, and also serves as a main storage water supply to the building. The water supply is taken in duplicate from two different points of the public system



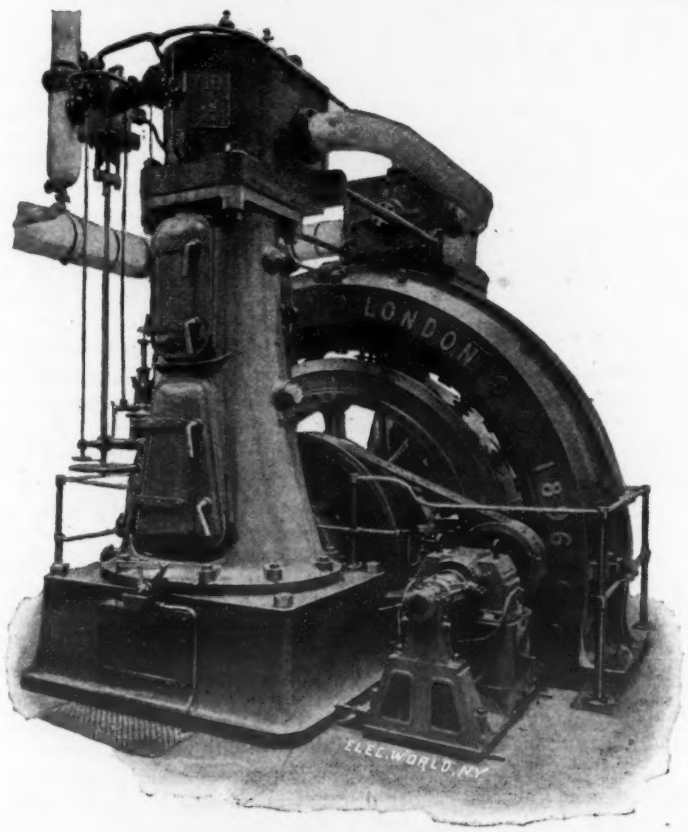
The Day Load Generating Unit

to this water tank. The feed pumps can also draw water from the public supply instead of the tank or the hot well, if necessary. An air pump of 500 gallons capacity draws the condensed water and delivers it into the hot well, from which it is pumped through combined filters and oil extractors back to the boilers.

The engine room plant comprises three main engines and dynamos, one smaller engine and dynamo for the day load, the arc-lighting apparatus and the switchboard. The three main engines and dynamos are of Messrs. Ferranti's special design, each unit being capable of carrying about 2000 16-cp lamps, or their equivalent. The engines are of the vertical cross compound type, with working parts inclosed by cast-iron box columns, which support the cylinders. The main shaft is hung in two bearings only, the fly wheel and dynamo rotor being mounted between the bearings and both cranks being overhung. The engine cylinders are 15½ inches and 25½ inches in diameter by 18 inches stroke, the speed being 150 revolutions per minute. The low pressure valve is driven by a link, which can be regulated by hand to give the proper cut off.



RECTIFIERS FOR ARC LIGHTING SUPPLY.



A GENERATING UNIT SHOWING EXCITER.

The high pressure slide valve is driven by a McLaren patent automatic expansion governor, which controls the speed within 3 per cent. from no load to full load. Inside each crank case, in which the working parts splash in oil, is an oil pump driven from the crank pin to keep all parts lubricated under pressure, which is commonly kept at 20 pounds per square inch. All valves and drain cocks are provided with handles convenient to the floor level.

The generators of 125 kw capacity are of the Ferranti disc type, in which there is no moving iron, the armature coils being fastened by insulated bolts to the fly wheel rim, and revolving edgewise between the field poles. The coils are built up of copper tape, wound on hard brass cores and carefully insulated. They are built in pairs, the holder completing the electric circuit between the two coils. There are twenty such pairs to each machine, connected in two series of ten coils each, the two series being in parallel. One terminal of the machine is grounded by a connection directly to the fly wheel. The other terminal is connected to a gun metal collector ring mounted on porcelain insulators. The fly wheel is built in two halves, bolted together at the rim and further secured by steel links shrunk in recesses at the joints. No keys are used to fasten it to the shaft, steel shrink rings being depended upon. The outside diameter of the armature disc is 12 feet 6 inches, the total revolving weight being 9 tons. The field magnets are mounted in frames which surround the armature disc on either side, the field coils being wound with copper strip on edge, thus securing one layer of winding with the best possible ventilation. The eighty field coils are all connected in series. Shunt wound, continuous current exciters stand on the floor level beside the main machines, and are rope driven from the governor wheels.

For carrying the day load a 25-kw generating unit is provided, consisting of a Belliss closed-in, high-speed engine, with forced lubrication and a Ferranti revolving field magnet and fixed armature alternator. The speed of this unit is 450 revolutions per minute.

The engine is of the vertical compound type, with cylinders 7 and 11 inches in diameter by 5 inches stroke. The speed is controlled by a throttle-valve governor. The field magnet, which is also a fly wheel, is excited by one large coil concentric with the shaft, and supplied with current from a continuous-current dynamo coupled to an extension of the main alternator shaft.

The arc light circuits are fed by three Ferranti rectifiers, each of which is designed to light fifty 12-ampere series arc lamps. The synchronous motors and rectifying rings proper are mounted on tables, below which are the constant current transformers and regulators.

There are two switchboards, one for the alternating circuits and one for the arc lighting service. The former is divided into panels, one panel being provided for each dynamo and one for each circuit. All the apparatus on the board is single pole, each circuit being provided with a single pole switch, fuse and ammeter. The switches are specially designed with a very long break, and arrangements are made in the dynamo circuits so that when each machine is brought into parallel connection is first made through a synchronizing apparatus. The fuses are of Messrs. Ferranti's patent oil-spring type, duplicate fuses being mounted on every panel. Above the main switchboard two main voltmeters of the Kelvin type are mounted, together with synchronizing lamps. On the arc lighting board arrangements are made for any of the rectifiers to be connected to any of the arc lighting circuits. Each circuit is provided with an oil fuse, an ammeter and a current direction indicator.

The current generated is distributed by means of concentric cables laid throughout in cast iron pipes. The outer conductor of the alternating current cables is carefully grounded, but both sides of the arc cables are kept insulated from the ground. All draw-in boxes are of the best of cast-iron, and the pipes in every box are plugged in so that so far as possible gas will be excluded. The high pressure cables lead to the sub-stations, where the pressure is transformed and the current distributed by a network of low-pressure mains, which are interconnected so that the opening of any one circuit will not cut off the supply to any district. Spare pipes are provided to the principal points, so that future circuits may be added without reopening the streets. The low-pressure cables are insulated by impregnated jute, and protected by a lead sheathing and a double armoring of steel tape. They are laid without further protection in the ground beneath the pavement. The arc lighting cables are laid in a separate system of pipes, the two sides of the street being served by separate circuits, so that in the event of failure of either circuit the streets will not be placed in darkness. The whole of the high and low pressure systems was tested in place with over three times the working pressure. There are at present six sub-stations provided, five of which are under the pavement and roadway. Each of these is about 8 feet by 9 feet in plan, and 7 feet high, access being provided by means of a manhole about 3 feet square. Siemens' transformers are used. The street lighting is effected by arc lamps from sunset to midnight, after which hour incandescent lamps are used. The arc lamps are placed between 70 and 110 yards apart, and are of the Brockie-Pell type, each rated at about 1200 candle-power, and fixed 20 feet above the ground. On the same post, about 6 feet below the arc lamps, are two incandescent lamps of 32 candle power each, connected to the low pressure mains. An automatic switch is placed in each of the posts, so arranged that when the arc lamp is extinguished the incandescent lamps are automatically lighted. The total cost of the system, as described above, has been about $200,000.

Conduit Tramways at Brussels.

A recent number of the *Elektrotechnische Zeitschrift* contains a description of the new lines lately equipped with the conduit system of the Union Electricitäts Gesellschaft. The conduits are placed under the two inner running rails of the double track, the slot coming between the guard rails and these inner rails. The two sides of the circuit are included in the conduit, the conductors being of I-beam section and the plow contacts being made on the tops of them. The conductor rails are in 33-foot lengths, the insulators being spaced 16½ feet apart. These are of vulcanite. The plow contacts are made of an aluminum alloy, the two contacts being fastened on spring hinges or flaps, so that the plow may be withdrawn through the slot. Each car carries two plows, only the one on the left of the direction of motion being used.

An Electric Curve Tracer—II.

FOR DELINEATING THE FORMS AND PHASES OF PERIODIC ELECTRIC QUANTITIES, VIZ., ELECTRIC CURRENTS, E. M. F., ELECTRIC POWER, MAGNETIC INDUCTION, AND HYSTERESIS CURVES.

BY PROF. EDWARD B. ROSA.

POWER CURVES.

Power curves, like curves of current and E. M. Fs., are drawn directly while the generator is running. A second solenoidal coil, 80 centimeters in length, is mounted in the instrument parallel with the first. It has a sliding contact propelled by a rack and pinion, shown in the figure. This second coil is of German silver wire, and is in series with a larger non-inductive resistance R; it carries a current proportional to the E. M. F. the terminals T T' being joined to the dynamo, or to the terminals of the circuit of which the power curve is to (Fig. 7) be drawn. Instead of using a fixed resistance, A B, as in other cases, the resistance whose terminals are A B is varied, being in each case proportional to the current at the instant of contact. This is effected by having B fixed at the middle of N' O'; and then setting A by the points printed by the extra electromagnet on the strip of paper when the current curve was drawn. When the current is negative A is on the right-hand side of B. The difference of potential between A B is proportional to the distance A B, and also to the current passing through the coil N' O'.

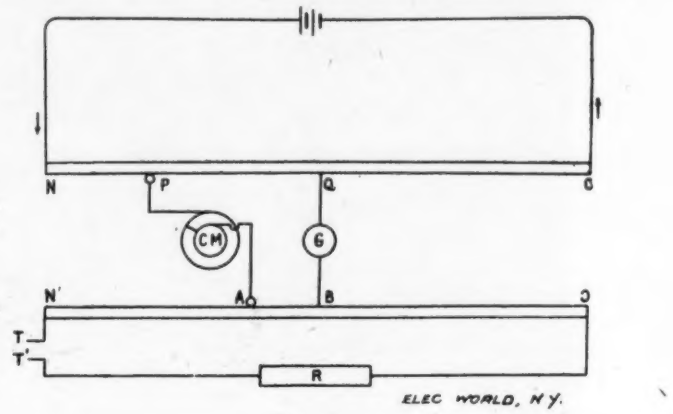


Fig. 7.

Since the former is proportional to i (the current), and the latter is proportional to e (the E. M. F.), the difference of potential of A B (and therefore of P Q) is clearly proportional to the product i e, which is the instantaneous power. Advancing the contact brush gives contact at a later instant of phase, when both i and e have changed. Setting the contact A to the new value of the current, and moving P until a new balance is obtained, a second point of the power curve is obtained. Obviously the power curve will cut the zero line whenever the current is zero (for then A comes to B), and also whenever the E. M. F. is zero (for then there is no current in N' O'). It has a positive loop when current and E. M. F. are both positive or negative, and a negative loop when only one is positive. Thus are power curves accurately drawn to a predetermined scale, and the labor of multiplying the corresponding ordinates of current and E. M. F. is avoided.

THE CONTACT MAKER.

Much of the success of the curve tracer depends upon the contact maker, and great care has been taken in perfecting it. The shaft of the contact maker is joined to the shaft of the dynamo (or perhaps to a synchronous motor) by a coupling shown in the figure. At the nearer end of the connecting rod the latter is joined to the plate (which latter is fastened rigidly to the shaft by a collar and set screw, as shown, by a flexible steel diaphram, so that perfect alignment of the contact maker and dynamo is not necessary. At the further end the plate carries two steel pins, one at its centre and one near its edge, which fit loosely into two corresponding holes in a plate clamped to the end of the dynamo shaft. Thus the end play of the armature is not communicated to the contact maker, and when the latter is clamped to a firm base the shaking and jarring of the dynamo are not transmitted to the contact maker. Two oil cups carry a good supply of oil, and the shaft carrying the hard rubber disc runs as smoothly as a top, hour after hour, if desired, with very little attention.

The galvanometer current, which flows momentarily when the knife edge in the hard-rubber disc passes under the contact brush, enters at the binding post, which is seen behind the left-hand oil cup, passes through a brush to a slip ring on the left of a large disc, and

from there to a steel knife edge or contact piece let into the edge of the hard rubber disc. Passing to the brush and insulated brush holder the current flows to a second slip ring, and away by a second brush and binding post on the right. The mechanism which advances the brush can be understood by comparing Figs. 3 and 4. The teeth of the ratchet and large gear are numbered, so that the initial position of the brush can be recorded, and the brush returned to the same position for the beginning of successive curves. The milled head on the end of the spindle which carries the ratchet wheel and pinion enables one to set the brush quickly by hand at any desired place. The two binding posts seen at the back of the base are the terminals of the coil of the electromagnet which operates the ratchet.

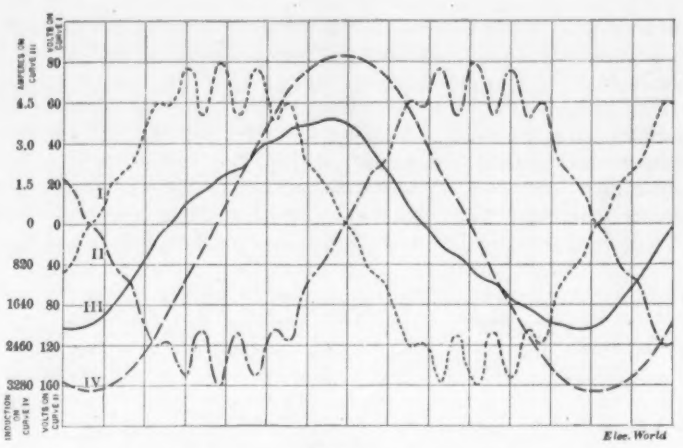


FIG. 9.

THE CURVES.

Fig. 8 shows two curves of E. M. F. drawn upon the curve tracer. Curve 1 is the E. M. F. of a small eight-pole Westinghouse alternator. The ripples which appear along the sides of these waves and the strongly marked peaks at the tops of the waves are due to the teeth of the armature. The induction through the air from the pole pieces to the armature is not uniformly distributed, but is tufted, and the induced E. M. F. shows fluctuations of a corresponding periodicity. The distance apart of consecutive teeth in this case is one-seventh of the distance between two consecutive peaks is one-seventh of half a wave length poles; and hence the distance apart of these or one-fourteenth of a whole wave length. But since the positive and negative half waves are alike in form as well as in average value, there can be no even harmonics present in the wave. These ripples, in fact, consist chiefly of two odd harmonics, one having thirteen and the other fifteen times the frequency of the fundamental. These two sets of wavelets reinforce each other at the maxiumum regions of the fundamental, and produce ribbles or peaks of double amplitude. On the sides of the waves, however, midway between the summits, the two waves are in opposite phases and nearly annul each other. In general, if the distance apart of two consecutive teeth of the armature is $\frac{1}{n}$ th of the distance of two consecutive poles, there will be introduced into the E. M. F. wave two harmonics of $(2n-1)$ and $(2n+1)$ times the frequency of the fundamental. Steinmetz proves this theorem analytically. ("Alternating Current Phenomena," p. 324.)

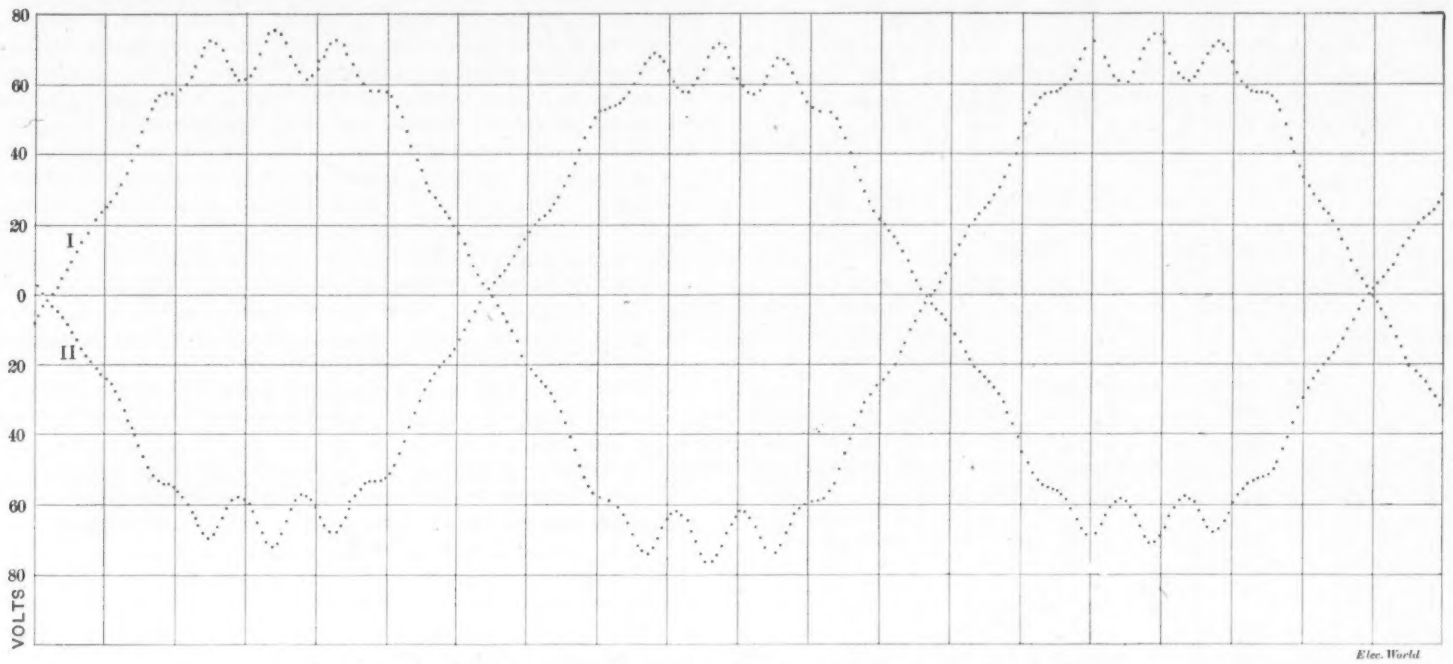


FIG. 8.—THIS REPRODUCTION SHOWS THE DOTS AS MADE BY THE CURVE TRACER.

But apart from these higher harmonics, which are attributable to the teeth of the armature, the curves would not in general be a simple sine curve; for that would necessitate a particular distribution of magnetic induction, which would seldom occur. Upon analysis we find three other harmonics of frequencies, three, five and nine times the fundamental.

This E. M. F. being now impressed upon the primary coil of a transformer, the secondary E. M. F. is opposite in phase and has a similar form. This secondary E. M. F. can then be impressed upon another transformer, and its secondary E. M. F. will be of opposite phase to the latter, and also have the same form. In order to see whether such transformations would affect the form of the original dynamo E. M. F. I joined five transformers in series, and drew the various E. M. F. curves.

In Fig. 8 Curve 1 is the first and Curve 2 is the last of the series. The very close agreement of thse curves is striking. The last is nearly opposite in phase to the first, differing about 1° 6′ from exact opposition. The E. M. F. of the dynamo is 50 volts; by the first transformer it is raised to 100, by the second it is dropped to 50, by the third it is raised to 700, by the fourth it is dropped to 50 again. The last transformer is not loaded, save for the small current flowing through the shunt coil, and used in drawing the E. M. F. curve. Fig. 9 gives several curves taken from a single transformer joined to the same generator. A condenser is also joined to the dynamo, and its capacity varied until there is resonance with the upper harmonics. The armature reaction is then such as to increase the amplitude of these upper harmonics. In other words, the armature reaction of the condenser current augments the tufting due to the armature teeth, and the ripples are of double amplitude both in the primary and secondary circuits of the transformer.

Curve 3 is the primary current, the secondary circuit being open. The ripples along its up-slope show the effects of the upper harmonics of the E. M. F. The beautiful work of the instrument is well illustrated here. Under each "valley" of the E. M. F. wave is a corresponding depression in the magnetizing current. A displacement of a dot by its own breadth would mar the curve seriously. The dots are so accurately placed by the instrument that a magnifying glass is used in reading off the values of the ordinates of the curves when about to analyze for the harmonic components.

Curve 4 represents the magnetic induction in the iron. It is a derived curve, and is drawn as already explained, showing its proper phase relation to the other curves. The minute accuracy of the original curves is not apparent from the accompanying repro-

ductions on a smaller scale. Along the side of Curve 4 ripples appear in the original which are the cause of the larger ripples in Curve 2.

Fig. 10 shows three current waves as drawn in August, 1896, upon the first curve tracer constructed. The total length is a little more than a wave length and a half of the fundamental. The upper harmonics are very pronounced. The currents are all condenser currents; that is, the currents flowing to and from

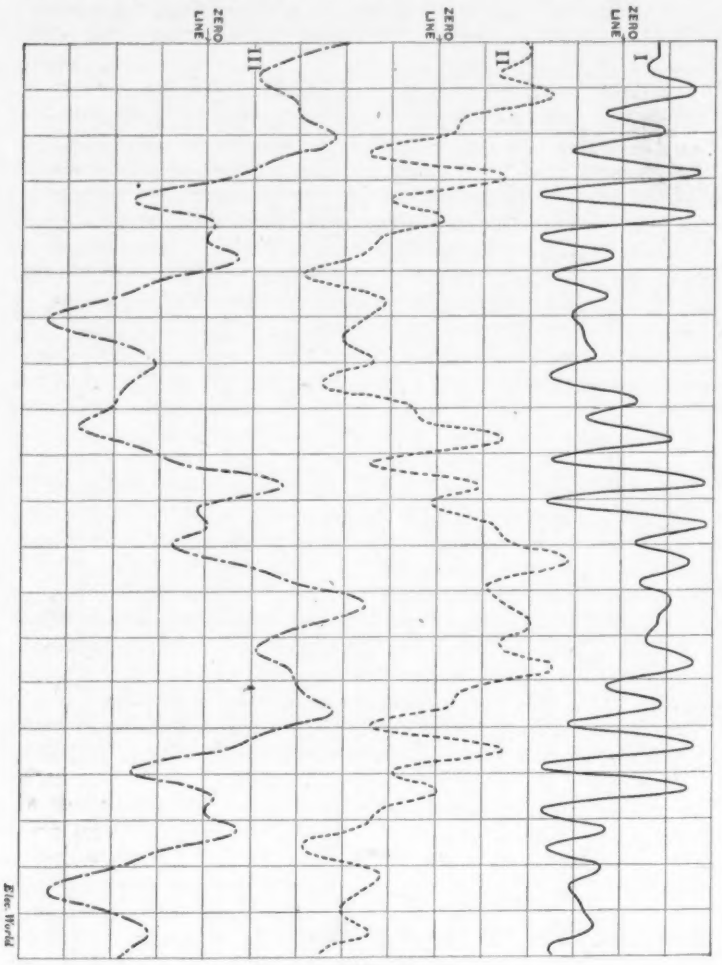


Fig. 10.

condensers of varying capacities when joined to the secondary of the transformer used in drawing the curves of Fig. 9.

In a condenser, $i = C\frac{de}{dt}$, where i and e are the instantaneous current and E. M. F. respectively, and C the capacity of the condenser.

The armature reaction of these condenser currents is, of course, different for different values of the current. Hence the form of the E. M. F. wave will vary according to the capacity of the condenser employed. Hence the form of the current wave itself will vary with the capacity, which it would not do if the E. M. F. wave were of constant form. Curve 1 was drawn with a capacity of 1.7 micro-farads, Curve 2 with 3.4 micro-farads, Curve 3 with 6.8 micro-farads. In Curve 1 the strongest harmonics are the thirteenth and fifteenth, in Curve 2 the fifth and ninth are strongest, though the thirteenth and fifteenth are prominent; in Curve 3 the fifth is much stronger than any other.

Comparing the first part of each of these waves with the last part, a wave length distant, one sees how perfect is the work of the curve tracer. The instrument lends itself to a great variety of purposes. One can study the actions and reactions in dynamos, motors and transformers, of single-phase and polyphase varieties, as well as of special devices in practical or abstract research. By means of a two-part commutator on the shaft of the contact maker the oscillating current of condenser charges and discharges can be delineated, and their period measured. Curves showing the rise and fall of current in inductive circuits, when the circuit is made and broken, can be drawn, and the self-induction thereby determined.

In conclusion, I wish to express my obligations to Mr. O. S. Blakeslee, the accomplished mechanician of the college, for his assistance in designing the mechanical features of the curve tracer, and for his skill in constructing the instrument; and also to Mr. R. H. Hopkins, M. A., for his assistance while a graduate student and assistant in my laboratory in the earlier part of the work.

Small Lighting Plants.

BY FRED'K C. REEVE.

There is perhaps no subject of more general or widespread interest to-day than that of interior lighting. Our homes, our places of business or amusement, all alike are demanding a better artificial light, both in quality and quantity.

The congested population of our large cities, with buildings in solid masses of brick, stone and steel, in many instances requiring artificial illumination, day and night, makes the economical production of this light a necessity.

In this modern age of competition, stores, large and small, must be kept brilliantly lighted, which means the expenditure of considerable money for this item of running expense alone. In order to meet trade prices to-day all running expenses are necessarily cut to a minimum or failure is inevitable.

Large establishments using 500 lights and over are coming to see the saving gained by running their own lighting plants, many of which are already installed.

However, where only small numbers of lights are in use, almost universal practice favors taking the supply from central stations under the control of large corporations.

The object of this article is to try to answer three questions:

1. Can the lighting companies materially lower the present rates if brought in competition with the "isolated plant?"

2. Are very small plants, varying in size from 25 to 300 lights, practical?

3. Under what conditions can they be made a success financially?

The four great sources of illumination suited to interior lighting to-day are:

A.— Ordinary gaslight, costing .875 cents per 16 cp h.

B.—Incandescent gaslight, costing .65 cents per 16 cp h.

C.—Incandescent electric light, costing .90 cents per 16 cp h.

D.—Enclosed arc light, costing 6 cents per 1500 cp h.

These lights are supplied by large corporations at the above average prices, which cannot be materially reduced. For although improved generating machinery, or in certain localities the utilization of natural water power, materially decreases the fuel bill, still there are other items inherently connected with central station work far more serious. A large corps of workers, engineers, firemen, dynamo tenders, linemen, meter readers, drummers and inspectors, in addition to a good business management, necessitates a very heavy pay roll, compared with the business done. Added to this are the items of interest and depreciation on the investment. The generating plant is expensive, both in first cost and maintenance, and in nearly every case the largest item of all is the distributing system of pipes or lines. The underground system, with its enormous first cost, and the overhead system, with its high maintenance expense, especially in severe climates, constitute a continual drain on the resources of the company.

These three items form a barrier insurmountable in the road of any radical reduction in prices.

If then the central station cannot in the near future materially lower its present rates, we are brought to face the second question: "Is the small isolated plant (25 to 300 lights) practical?"

Dynamo machines can be and are built to-day of any capacity from one light up, capable of running practically without attention, if the source of driving power holds the speed of the machine constant at all loads.

Steam engines can do this work, but the economical running of steam plants requires high pressures, and this feature requires for its safe manipulation an engineer, whose salary would soon more than eat up the saving gained by operating such a plant. But there are on the market to-day gas, gasoline and oil engines, which will run without expert attention at a very low cost per horse-power, and furnish the desired power.

Where gas is the fuel at $1.25 per thousand, the cost of fuel and lubricating oil is from .3 to .2 cent per 16-cp hour, depending on the size of the plant. When operated with gasoline the fuel bill is reduced about one-half.

Such plants are not mere conceptions, but are in successful practical operation to-day. Why, then, is their number so limited? One

answer might be that the engines capable of doing this work are new and have been on the market but a short time, which is true. Another is their first cost, which is high. But the best reason is that an item of running expense is often overlooked, namely, the interest and depreciation on the plant. Although there may be some variation in this expense, figuring at 15 per cent. of the first cost of the installation will give an average not far from the truth. It should be noted that figured in this way this factor is a constant quantity, and bears no relation whatever to the running time of the plant.

If the number of lamp hours burned per year is small compared with the capacity of the plant, then, dividing the interest and depreciation figure by this total number of lamp hours, this cost per lamp will be large. Adding this figure to the cost of fuel and oil will give the true cost of production per light, which, under the assumed condition, may be higher than central station rates. If this is so, then the plant is running at a loss, and financially is a failure.

On the other hand, if the required number of lamp hours is large compared with the maximum capacity of the plant, then the resultant figure obtained by dividing the same constant quantity by this larger number will be small, and the total cost per lamp hour will figure much smaller.

The accompanying table gives the cost of running four different sizes of plants from one to six hours each day for 300 days per year at full load, and shows clearly that where the lights are only required a short time each day there cannot be any saving unless the plant is very large.

Right along this same line we often find the statement that if gasoline is used for fuel then the cost per lamp hour is one-half that when gas is the fuel, since the quantity of gasoline necessary to develop the same power only costs one-half. In the light of the above discussion this statement is not true, and could not be true, even if the plant were run at full load twenty-four hours a day.

Reference to the accompanying table shows the saving, which is not larger than 30 to 35 per cent., even when the plant runs six hours per day, which is probably the longest running time averaged, except in some few special cases.

Hence, our third question of financial success must be answered both yes and no. Yes, when the lamp hours used are large compared with the size of the plant, and no, when large numbers of lights are required only intermittently, or for a short time each day. Nor is the isolated plant adapted to domestic lighting, except for country residences, where the current cannot be obtained from any other source.

There are, then, two fields which central station management has striven to fill, but if the above discussion be true it is only a question of time until the central station must give up the steady commercial lighting to the isolated plant, even where the total number of lights is small, and retain only the domestic and intermittent commercial work. A man will pay for the convenience afforded by the central station in his home, but the time is fast approaching when his store, factory or workshop will be lighted by the cheaper and more modern method, the isolated plant.

TABLE OF COSTS OF OPERATING PLANTS.

Max. capacity of plant in 16 cp lamps.....	25	50	80	100
Average first cost of plant	$400.00	$650.00	$900.00	$1,100.00
Interest and depreciation at 15 per cent..	60 00	97.50	135.00	165.00
Cost of gas and lubricating oil per lmp. hr.	0.30	.26	.25	.24
" gasoline " " "	0.16	.14	.13	.12
Cost per lamp hour of running with full load, 300 hrs. pr. yr. Gas.....	$1.01	$0.91	$0.81	$0.70
Cost per lamp hour of running with full load, 300 hrs. pr. yr. Gasoline.	0.96	0.79	0.70	0.67
Saving, per cent.....	13	13	14	15
Cost per lamp hour of running with full load, 600 hrs. pr. yr. Gas.....	$0.70	$0.59	$0.53	$0.42
Cost per lamp hour of running with full load, 600 hrs. pr. yr. Gasoline.	0.56	0.47	0.42	0.40
Saving, per cent.....	20	20	21	23
Cost per lamp hour of running with full load, 900 hrs. pr. yr. Gas.....	$0.57	$0.48	$0.44	$0.42
Cost per lamp hour of running with full load, 900 hrs. pr. yr. Gasoline.	0.43	0.36	0.32	0.30
Saving, per cent.....	25	25	27	29
Cost per lamp hour of running with full load, 1200 hrs. pr. yr. Gas.....	$0.50	$0.42	$0.39	$0.38
Cost per lamp hour of running with full load, 1200 hrs. pr. yr. Gasoline.	0.36	0.30	0.27	0.26
Saving, per cent.....	28	29	33	33
Cost per lamp hour of running with full load, 1500 hrs. pr. yr. Gas	$0.46	$0.39	$0.36	$0.35
Cost per lamp hour of running with full load, 1500 hrs. pr. yr. Gasoline.	0 32	0.27	0.24	0.23
Saving, pea cent.....	30	30	33	34
Cost per lamp hour of running with full load, 1800 hrs. pr. yr. Gas.....	$0.43	$0.37	$0.34	$0.33
Cost per lamp hour of running with full load, 1800 hrs. pr. yr. Gasoline.	0.29	0.25	0.23	0.21
Saving, per cent.....	33	33	33	36

The Tendency of Central Station Development.

I. THE DISTRIBUTION SYSTEMS.

The problem of distributing electricity for the general purposes of incandescent lighting, arc lighting and power development has undergone during the last few years a remarkable change. Some ten years ago there were two opposing and rival systems recognized. The first, that of the low pressure continuous current distribution, was exemplified mainly by the Edison three-wire system; the second was the high pressure single phase high frequency alternating system, with its multiplicity of independent dynamos and feeders, and its small house to house transformers. The first system was obviously applicable only for short-distance work, and hence was practically limited to localities where the population was dense, as in the large cities. This system of distribution, on the whole, was economical of power, although expensive in first cost, especially when the cities became educated to the point of compelling the placing of all wires underground. The second system had the advantage of low first cost, but the disadvantage of extremely low efficiency, although the losses were not readily seen and are not yet well recognized, as they are individually small and widely distributed. The alternating-current system was obviously applicable in small towns and scattered residential districts, where the load was so distributed over considerable territory that the cost of feeders for a low pressure system would be prohibitory.

In this way the two systems grew together, the one supplying the densely populated cities, and the other the small villages, towns and suburbs. Instead of further differentiating themselves and going to greater extremes of higher and lower pressures, the two systems now are strangely developing toward a common mean. The low pressure advocates found that with the increased size of cities their methods required a plurality of generating stations, situated often on valuable land, and often necessarily located for the purposes of copper economy where the advantages of condensing water and cheap fuel were inaccessible. In the effort to centralize their generation system at points favorable for the cheap handling of fuel and machinery they have found a means of utilizing high pressure alternating current distribution systems.

The means of accomplishing this combination is the rotary transformer. By its aid, with the help of the better known voltage transformer, the high pressure multiphase alternating current transmitted from generating stations placed wherever the cheapest coal, water and site can be obtained can be transformed simply, cheaply and efficiently into direct current suitable for the operation of lamps and motors. By this means the centrally located generating plants, with their expensive sites, their comparatively expensive fuel, their wasteful atmospheric exhaust and their comparatively small generating units, can be abandoned or replaced by comparatively small rotary sub-stations.

Further economy is effected on such systems by the use at the sub-stations of storage batteries. It was once said of alternating-current systems that one of their chief disadvantages was that they could not be connected to storage batteries. This impossibility has now fortunately disappeared. By their application at the sub-station the load on the generating boilers, engines, dynamos, the transmission line, the voltage transformers and the rotaries is rendered uniform, thereby reducing their necessary size from that sufficient to carry the peak of the load to that sufficient to carry the average load. The thermodynamic efficiency of steam motors is also improved by the use of storage batteries, owing to the constancy of the load, and the losses in the generating and transmitting systems are reduced, as these losses depend upon the integrated square of the current, which is much less when the current is uniform than when it is variable.

The advocates of the high pressure alternating-current systems have come also to recognize that the use of a large number of small transformers on their lines in twenty-four-hour service, each transformer being of sufficient size to carry an emergency load, which occurs only on occasions of special celebrations, the average load on the transformer being perhaps 5 per cent. of its rated output, is extremely wasteful. The small transformer of ten or twenty lights' capacity wastes constantly in its core a certain amount of energy, which, when compared with its rated transforming capacity, gives an attractive efficiency percentage, generally over 90 per cent. When, however, the average load is only, for example, one-twentieth of the rated load, the loss becomes in proportion twenty times as serious, and the efficiency in actual operation may and often does fall below 50 per cent. The only remedy for this in the case of widely scattered

loads is the use of high pressure transmission lines, feeding, in transforming stations, a low pressure distribution network. This modification is rapidly coming into use on such systems, with the added change to a lower frequency, by which the iron losses in generators and transformers may be reduced and inductive effects in the lines rendered less troublesome.

The best all-around frequency is a subject on which there are about as many opinions as there are students of the question. The common frequency in central station lighting work varies from 100 to 133 cycles per second. At the other extreme may be mentioned the frequency adopted at Niagara Falls, of 25 cycles per second. Modern central station and power transmission practice ranges between these two, 40, 60 and 72 cycles being common figures. The adoption of any one frequency is a compromise between two opposing requirements. On the one hand a high frequency reduces the cost of construction of voltage transformers, owing to the more rapid rate of change of lines of force, and consequently higher voltage per turn. On the other hand, the low frequency is almost essential for the construction of induction motors, and especially of rotary transformers. It has often been thought also that low frequencies, such, for example, as that of the Niagara Falls power plant, would be too low for incandescent lighting work, because of the flickering that would be visible to the human eye. This, however, appears not to be the case, although a final decision on this question should not be made until the question of the effect of low frequency on the eyesight is tested. It is possible that at frequencies where the flickering is inappreciable, owing to the continuity of the image on the retina of the eye, there may yet be a strain on the optic nerve due to the invisible flickering.

The difficulty of constructing rotary transformers for high frequency alternating current can best be illustrated by a hypothetical case. Assuming for purposes of illustration an alternating current at a frequency of 60 cycles per second, from which it is desirable to obtain direct current at 500 volts,the rotary, if bi-polar, would necessarily run at a speed of 60 revolutions per second, or 3600 per minute; if multipolar, with perhaps six poles, the speed would be 1200 revolutions per minute. The maximum permissible peripheral speed of an armature for reasonably cool and efficient running at a magnetic induction about on the bend of the curve, is about 7200 feet per minute. This limits the diameter of the armature of our desired rotary to about 23 inches. A 500-volt commutator for this six-pole machine with a safe voltage per segment would have to be larger than the armature, unless its segments were made unsafely narrow. The problem becomes less difficult at lower voltages, owing to the smaller number of commutator segments necessary. Forty cycles seems, however, to be about the maximum frequency where rotaries are to be used for 500-volt work.

For the greatest economy in an alternating-current sub-station distribution system, the secondary pressure should be more than 110 volts. If limited to this, either the distributing mains will be necessarily very large and expensive, or the sub-stations will have to be numerous, near together and small in size. The three-wire system is readily applicable, but owing to the patent rights, which still have three years to run, is somewhat limited in its applications. Where the system is multiphase, the four-wire three-phase distribution is admirable, the economy of copper being even greater than that of the three-wire single-phase and the multiphase feature allowing the use of alternating-current motors. The only disadvantage is the necessary approximate balancing of the load between three circuits instead of between two, as in the Edison three-wire system.

The almost universal practice of ten years ago was to supply arc lights, incandescent lights and motor service on three independent systems, necessarily supplied by separate generators. The enormous advantages to be gained by supplying electricity for all purposes on one set of distributing wires and from one type of generating unit have gradually led to attempts, not very widely successful as yet, but promising well for the future, to consolidate the three kinds of service. In arc lighting the builders of series machines have constantly increased the size of their generators in answer to the demand for larger and more efficient machines, until the limits of safe pressure have been passed. The peculiarity of the simple series system, that every added lamp increases the pressure on the line by 50 volts, has led to the design of various types of generators, styled "multicircuit," to overcome this feature. One of the most ingenious of these is the division of the load into several approximately equal parts inserted between the active sources of E. M. F. Various other devices have been tried, but without producing machines large enough for efficient direct coupling to engines of accepted speeds, and of sufficient size for economical steam consumption. This line of progress also in no way helps the common working of arc lights and other loads on the same circuits and generators.

A more promising development is that of the constant-potential arc lamp. For many years this has been necessarily installed in sets of two on direct-current circuits, owing to the fixed pressure of 50 volts across the open arc and the standard pressure of 110 volts on distribution mains. During the last few years, however, the development of the enclosed arc, whereby the distance between the carbons can be lengthened and the pressure raised to a value ranging between 65 and 80 volts, has allowed fairly efficient running of single arcs on 110-volt circuits. The waste of energy in the reducing resistance by which the pressure on the line is lowered to that across the arc does not seem to be any bar to the use of such lamps. It is more than likely that this waste, serious as it is, is less than the losses incurred in the belting, countershafting and small inefficient machines necessary for series arc lighting, as compared with the large direct-coupled constant-potential machines and their highly efficient driving engines. The alternating current enclosed arc lamp is a still later development, and here the loss of the choking coil may be largely reduced, as it may be and is made highly inductive, so that the fall of voltage, instead of being wasteful, is of the nature of a back E. M. F., throwing the energy back to the generator. The main disadvantage of this arrangement is the low power factor involved, which requires a greater current in the generator, transformers and lines than is justified by the energy consumed, and consequently increases the losses in those parts of the system, and also interferes with the regulation of the generating dynamo.

The greatest difficulty in systems using only alternating current is the problem of motor supply. The alternating current synchronous motor is a perfectly satisfactory piece of apparatus, where uniform speed and constant running are required. It requires as a rule auxiliary apparatus in starting and some source of direct current for field excitation, these disadvantages being slight in large units, but serious in extended systems of small units. The induction motor with multiphase supply is of all electrical generators or motors the most simple and capable of the greatest abuse. It is also readily self-starting and capable of running at various speeds. However, it introduces into the lines feeding it that bugbear of the central station manager, the wattless current. This can be reduced by lowering the induction of the motor and diminishing its air gap, at the cost of mechanical danger to the motor. With the best of care, however, induction motors introduce, particularly on low loads, considerable lagging currents into the circuits, increase the heating losses in all the apparatus and pull down by their reaction the voltage of the generators. The alternating-current motor has not, as yet, been adapted to the particular needs of such special devices as elevators, direct-connected presses, machine tools, etc., so that from the supply of such machinery the alternating-current systems are at present debarred. There is no inherent reason, however, why the alternating-current motors should not be used for such apparatus as well as the direct.

Proposed Hawaiian Cable.

A meeting of the Pacific Cable Company of New York was held last week at the office of the Central and South American Telegraph Company in New York City. The following board of directors was elected: J. Pierpont Morgan, Edmund L. Baylies, J. Kennedy Tod, Rear-Admiral John Irwin, United States Navy, and James A. Scrymser. James A. Scrymser was elected president, and Edmund L. Baylies vice-president and acting treasurer.

The company announces that its proposed cable will connect San Francisco with the Hawaiian Islands near Honolulu; extensions from the Hawaiian Islands will be made to Japan and Australasia. The surveys for the cable between the coast of California and the Hawaiian Islands are highly satisfactory, and arrangements are being made for the establishment of that section within eighteen months. Deep-sea surveys in the southwestern Pacific show a remarkably even bottom, much more favorable than the older charts indicated.

It will require over 9,000 miles of cable to connect the United States with the Hawaiian Islands, Japan, China and Australasia.

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES COMPILED FROM FOREIGN AND AMERICAN JOURNALS

BY

CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Measuring the Slippage in Three-Phase Motors. SCHUELER. *Elek. Zeit.*, Nov. 4.—A determination of the slippage, that is, the fall in speed below synchronism of a non-synchronous motor, is important for the constructor, but the usual method of determining it, from the actual speed and the speed of synchronism, does not admit of obtaining any more than very crude results, which may be incorrect to 50 or 100 per cent. as the figure obtained is simply the difference between two others which are nearly alike; difficulties are increased when the current is received from a distant central station. He then describes, with an illustration, a comparatively simple device for measuring the slippage directly. It consists essentially of a Joubert insulated disc with a contact on it, through which the current is passed, the disc being turned by the motor to be measured, but through the medium of a cone pulley or other device for varying the speed; the rotating contact is connected with one pole of the motor and the sliding contact, through a suitable resistance, with the other terminal; at every contact a spark will be produced, and it will remain at a constant brightness if the speed is equal to the frequency divided by a whole number, but in any other case it will become less and greater in regular alternations; in the latter case, the speed is changed until these oscillations cease; the slippage is then calculated directly, as it is equal to one less the quotient of the speed of the motor divided by the speed of the disc, which latter is equal to the frequency divided by a whole number, which is equal to the number of poles of the motor. He then describes an apparatus which may be held in the hand and applied like a speed counter; it consists of a cone against different parts of which the contact disc is pressed; the axial movement of the contact disc to produce the constancy of the spark is read off directly on a suitable scale as a percentage indicating the slippage. (It seems that in the above-mentioned formula the result must be multiplied by 100 to give the slippage in per cent., although it is not so stated in the article.)

Tunnel Armatures. MENGES. Lond. *Elec.*, Nov. 12.—A communication in which he expresses disagreement with some of the explanations made by Baily (see *Digest*, Oct. 30).

Dynamos. GUILBERT. *L'Eclairage Elec.*, Nov. 6.—An illustrated description of a number of recent improvements, taken apparently from patent specifications.

Compounding Curve. BUTLER. *Amer. Elec.*, Nov.—A compounding curve is given, which shows a difference of from 3 to 5 volts between the ascending and descending values, this difference being due to hysteresis.

Dynamo Connections for Simultaneous Operation.—Amer. Elec., Nov.—Methods are given for connecting shunt machines in series and paraliel, and the connecting of series machines in series and parallel.

Universal Alternator. CARHART. *Amer. Elec.*, Nov.—A description with working drawings of a 1 1-2-kw alternator, giving single, two and three phase currents at will.

Dynamo Testing. SMITH. *Amer. Elec.*, Nov.—A criticism of an article in the preceding issue, to which the writer replies. Also the application to railway motors of the "stray-power method" of testing.

LIGHTS AND LIGHTING.

Maxim Lamp. MAXIM. Lond. *Elec.*, Nov. 12.—A short communication in reply to an editorial inquiry about his lamp. He states that the reports which have appeared have all come from a recent interview with an American newspaper reporter; his remarks made at that time are quoted. It seems that he is experimenting with lamps, and is now testing them; a candle power was obtained with considerably less than two watts; he is running a number of these lamps and some have been burning 1000 hours; what he attempted to do was to produce a lamp in which a very high resistance might be obtained with a short thick filament; also to produce a filament which will stand a higher temperature than the ordinary; the preparation of the carbon "and other materials" which form the filament required a very expensive apparatus, but the cost of the finished filament is not greater than with the ordinary lamps; he has compared his lamps with all the best lamps and finds a very marked saving in current; he has not decided yet whether to keep the process a secret or to patent it.

The Arc. HERZFELD. *Wied. Ann.*, No. 11; abstracted briefly in the Lond. *Elec.*, Nov. 12.—He describes experiments testing the hypothesis that the counter E. M. F. of the arc is due to the deposition of electrified particles on the cathode; he deflected these particles on to a condenser plate and found that this produced no effect on the voltage. He also investigated the nature of the fungoid deposit and found that its growth was increased by inclosing the arc; he attributes it to the lack of oxygen necessary for complete combustion; the growth is a spiral whenever magnets are near, the twist being in the direction contrary to that of the currents in Ampere's molecular magnets. He also endeavored to determine the influence of the temperature on the voltage, blowing cold carbonic acid against the electrodes; the voltage increased equally whether the anode or the cathode was impinged upon; this shows that the counter E. M. F. is probably not a thermo-electrical effect.

Enclosed Arc Lamp.—Lond. *Elec.*, Nov. 12.—An illustrated description of the Davy lamp, including a curve of distribution in a vertical plane; the mechanism of the lamp appears simple, and seems to consist chiefly of a solenoid into which the carbon rod is drawn; it is made for alternating and for direct currents.

POWER.

Power Transmission Plants in Switzerland. SPENCE. Lond. *Elec. Eng.*, Nov. 12.—A reprint of a paper which it appears received a silver medal by a college society; it contains brief notes on some twenty Swiss power transmission plants which he visited; the most striking feature was the general adoption of alternating apparatus. The well-known advantages of the polyphase system (that is, more than one system) are enumerated, and he shows to what extent they are realized in practice, in which he is led to the following conclusions: The three-phase plant involves very much higher line pressures than would be necessary for a direct current constant potential equipment under like conditions; three-phase transmission at 10,000 volts with distribution by induction motors only compares unfavorably with direct current plants at little more than one-half the voltage; a long-distance transmission three-phase line has undoubted advantages over any other, but to realize these nothing but synchronous or non-inductive devices should be used; the best combination for really long-distance transmission comprises three-phase generators step-up and step-down transformers, rotary converters and a direct current distribution network, which is nearly but not quite the Niagara-Buffalo system; where a line pressure of 600 volts will give the necessary economy the three-phase apparatus is superfluous, a direct current plant being simpler and better; for short-distance transmission at or below 2000 volts the use of two or three-phase systems is generally disadvantageous; the polyphase system may be doing good work in Switzerland, but it would be out of place in England; its development is the result of cheap water power or a supposedly cheap water power. In conclusion he refers briefly to the Thury direct current series transmission.

New Water Power in Norway.—Zeit. f. Elektrochemie, Nov. 5.—Attention is called to a large water power of about 30,000 horse-power and a fall of 50 metres at Flekke-Fjord, on the southwestern extremity of that country. This has not yet been made use of; its chief advantage lies in the excellent location, which is immediately on the sea coast, where the largest steamers can land directly. The falls of Trollhaettan, which are at present being utilized, are 75 kilometres from Gothenburg, and if the necessary cost of transportation by railroad be capitalized it will show the greatly increased value of the other falls.

Electrically Operated Turntables.—Eng. News, Nov. 18; *West. Elec.*, Nov. 20.—A note giving some experiences with electric turntables by the Baltimore & Ohio Railroad. It was estimated that it cost 12 cents to turn each engine by hand; an electric motor was introduced on one of the tables at a cost of about $500, and it has been in use 2.5 years, giving such satisfaction that similar plants are being introduced; the cost is now found to be less than 0.5 cents for turning an engine, as compared with 12 cents by hand; it appears that the first cost, therefore, could be saved in less than four months.

Electrically Driven Printing and Binding Machinery. RATHBUN. *Amer. Elec.*, Nov.—A description of the electrical installation in the press and binding rooms of *McClure's Magazine.*

TRACTION.

Accumulator Traction on Rails and Ordinary Roads. Epstein. Lond. *Elec. Eng.*, Nov. 12.—The beginning of a reprint of an institution paper. Accumulator traction so far has only been a qualified success, but at present signs are not wanting that give promise of success; the chief defects were due to the accumulators and the way they were applied; heavy expenditures were incurred by the handling of the batteries; he recommends treating the battery as a mechanically and electrically well connected whole, either on or under the cars or operated on a separate car. He refers at some length to the Hanover combined system of trolleys and accumulators, giving some of the results obtained; the cost of maintenance, which was accurately ascertained, averaged $10 per car per month, which corresponds to 0.354 cent per car mile; this will not be increased to more than $15 when the accumulators get older; the cost of maintenance to keep the batteries permanently in a good condition has been found by experience to be 6 per cent.; accumulator traction incurs an additional expense of about 0.8 cent per car mile compared with the trolley; on the most unfavorable assumption the extra cost of the combined system compared with the trolley system alone does not exceed 0.4 cent per car mile in Hanover; the running expenses, including driver, amounted to 4.44 cents per car mile; he suggests carrying the accumulators on dummy cars, which are picked up at the end of the trolley section. He discusses briefly the system used in Paris, in which the charging is done in eight or ten minutes on the cars (this, as well as the Hanover system, has been described before in the *Digest*); no figures showing actual working cost are available. A dummy car with a battery for a fifty-two passenger car for about eight hours will weigh complete about 3 tons, and the extra weight of the dummy will increase the expense about 0.6 cent per car mile; the exigencies of traffic can be most effectively dealt with in this way, as one or more trailers may be used; the success or failure depends on the qualities of the battery; the nearest approach to the ideal cell will probably be one containing Plante plates, with a large surface and a thin layer of active material making intimate contact; the rate of charge and discharge depends on the surface, which may be made ten times as great as that of the plane surface; the acid should have free access to all the active material; lead oxides or salts might be used for the negative plate the oxygen of the positive plate produces a gradual falling of the voltage, while in the negative plates it produces a very sudden fall, for which reason the latter should be made to have a slightly higher capacity.

Motor Cars on Railroads. Thomieu. *L'Eclairage Elec.*, Nov. 6.—Some information on the motor cars which are being and will be experimented with on the Northern Railroad of France. The first type of these cars will include one driven by steam, using the Serpollet system, and the other will be electrically driven from accumulators; these will be used principally for mail, and will be run chiefly at a time when passenger traffic is not great. The second type will be exclusively electrical, and will be for passengers. The electric cars are under construction, and the steam car has been in service for some time; a description of the latter, with some data, is given; this is followed by a description of the electric postal car; it will seat twelve persons; the various weights of the parts are given; the other electric car will seat fifty passengers, and will weigh complete with passengers 24,100 kgs; the postal car weighs 15,540; descriptions of the tests are promised.

Electricity Replacing Steam.—Elek. Zeit, Nov. 4.—A note stating that the Belgian Government is at present building an electric railroad from Mons to Bousso, which is to be opened next September. It is called a "Vollbahn," which signifies that it is on the order of the regular steam lines, as distinguished from light railways.

Steam versus Electric Traction. Aspinall. Lond. *Elec. Eng.*, Nov. 12.—A brief abstract of a recent presidential address. He compared the figures for six months for the Liverpool Electric Railway with carefully taken data on a steam line where the conditions were not dissimilar; the locomotive expenses in the former were 7.34 cents per train mile, the speed being 12 1-4 miles; the train mileage was about the same, but there was considerable difference in the number of cars and weight of train, but reducing it to a common basis the cost per 100 ton miles for locomotive power was 19.34 cents on the Liverpool line and 9.78 on the steam line; the difference would be still greater if the renewal of boilers and machinery for generating the current were included; he is therefore inclined to think that we have not yet solved the problem of replacing steam by electric power with sufficient economy.

Mechanical Features of Electric Traction. Dawson. Lond. *Elec. Eng.*, Nov. 12.—A continuation (apparently the conclusion) of the reprint of his paper, the first part of which was noticed in the *Digest*, Aug. 21. It refers to the driving machinery and contains tables of some interest, giving data; the paper seems to be based mostly on American practice. It is followed by a brief discussion.

Motor Carriage. Elieson system. Lond. *Elec.* and *Elec. Eng.*, Nov. 12.—An illustrated description of the carriage, which has now been running for some months. The frame is made of steel tubes; there is one motor driving the rear wheels by means of chains, for which a slippage is provided, so as not to necessitate a differential gear; Lamina accumulators are used.

Electric Railways in Alexandria, Egypt.—L'Energie Elec., Oct. 16.—An illustrated description of the trolley line. The illustrations, accompanied by a brief description, are also published in the *West. Elec.*, Nov. 13.

Prague.—Zeit. fuer Elek., Oct. 15.—The first part of an illustrated article on the electric railways in that city.

Trucks.—Elek. Anz., Oct. 28.—Illustrated descriptions of several four-wheeled trucks for street railways, made in Germany.

Electric Carriage.—West. Elec., Nov. 20.—An illustrated description of the Rae carriage. Its weight fully loaded is 2000 pounds, and one charge will run it 60 miles over ordinary roads; there is a single motor geared to the rear wheels; tables are given containing "determinations" for level roads with a tractive effort of 60 pounds per ton (whether these are calculated or determined from tests is not clear, but it appears as though they were calculated); the torque, 121 inch pounds on the motor shaft, is absolutely the same for each of the four positions of the controller, for which the speed varies from nearly 4 to 20 miles; the efficiency increases rapidly with the speed; the currents for various grades are given; with 100 ampere hour cells and a maximum speed of 15 miles per hour it will run 60 miles on ordinary roads, the current consumed being proportional to the speed.

Motive Power for Traction.—West. Elec., Nov. 20.—A reprint of a short article from the *Railway and Engineering Review*; it is general in character, referring to the electrical system of traction, with special reference to the Heilmann locomotive, pointing out its possible advantages and those of the substitution of gas engines and accumulators on such a locomotive.

Budapest.—West. Elec., Nov. 20.—A reprint of one of the illustrated descriptions of the underground lines which were recently noticed in the *Digest*.

Electric Railway Testing. Monroe. *Amer. Elec.*, Nov.—Detailed instructions are given for making a road test; the arrangements of voltmeters and ammeters are illustrated and the application of the Boyer speed recorder described.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Distribution of Electrical Energy. Wordingham. Lond. *Elec. Eng.* Nov. 12.—The beginning of a reprint of a paper read before the Northern Society of Electrical Engineers. He refers to the requirements of cities and towns of considerable magnitude; he discusses the advantages and disadvantages of alternating and direct currents, considering it indisputable that there should be a low pressure network to which consumers can be directly connected; a storage battery can then also be used; the same applies to what he considers the most satisfactory system of mains, namely those made with bare copper, which cannot be used for alternating currents on account of the vibration produced; the meter question is more easily solved; no one system, however, is the best under all circumstances; it is simply a question of feeding the network; the distributing network can be discussed on its merits. He recommends a 200 volt three-wire system, but in certain cases 100 volts would be desirable; the question of uniformity is of vital importance; the balancing is not generally well understood; if the current in the neutral is nearly zero it does not necessarily follow that the balancing is good; each local district, and in fact each large building, should be balanced in itself; for balancing he recommends motor generators; he recommends one network for a whole city instead of isolated networks; short circuits cannot be sufficiently provided against by means of cut outs, but they should be burned out and then the advantages of a large network become manifest; the network should admit of heavy currents being delivered at any point for this reason.

Alternating versus Direct Current High-Pressure Systems.—Lond. *Elec. Eng.*, Nov. 12.—Brief replies to a question as to the relative advantages and disadvantages of these two systems.

Monocyclic System. Sahulka. *Zeit. fuer Elek.*, Nov. 1; translated in the Lond. *Elec. Eng.*, Nov. 12.—A reprint of a paper giving a brief description of his system. The latter journal also contains a short description of its advantages, by Tasker.

Switches for Three-Wire System with One Reserve Booster. Gruhn. *Elek. Zeit.*, Nov. 4.—An illustrated description of a switch for use with a three-wire system and accumulators, by means of which the booster can be used for charging the regulating cells in series with the main dynamo supplying the outside wires; or for charging the whole battery; or as a dynamo for either half of the battery; or as a reserve for either of the two dynamos connected with the respective halves of the system. Formerly it was required to use two boosters, one for each side; then a device was invented for using only one machine, for which an illustration of the connections is given; but with this system it is not possible to use the booster to supply current directly into the mains; this latter is accomplished by the switch which he describes. It is of advantage specially when a two-wire system with accumulators is to be enlarged into a three-wire system; it will then be necessary only to get the new dynamos and to double the battery, the old dynamo acting as a booster and reserve. The switch may be understood from the diagram alone.

Glasgow.—Lond. *Elec.*, Nov. 12.—An illustration, accompanied by a few notes, of this station. It is thought that there is no other station which is so crowded and at the same time as conveniently arranged as this one; there

is an aggregate of 3400 horse-power and a floor space of 2814 square feet (whether it includes the boilers or not is not stated), including passage ways, which gives a "plant density" of about 1.2 horse-power per square foot; there are direct-coupled high-speed generators; the three-wire continuous-current system is used, and it is intended to add storage batteries in a sub-station.

Cambuslang.—Lond. *Elec. Eng.*, Nov. 5; reprinted in *El'ty* (New York), Nov. 17.—A description of a small arc lighting plant driven by gas engines, in this small town near Glasgow.

Taunton.—Lond. *Lightning*, Oct. 28.—A brief discussion of this municipal station, which is of interest because it showed the possibility of changing an unprofitable business owned by a company into a municipal station that pays its way.

WIRES, WIRING AND CONDUITS.

Rules and Regulations.—Bul. Soc. Int. des Elec., Aug.-Oct.—The whole of this extra large issue of that journal is devoted to a reprint in French of the rules and regulations in countries other than France; it includes those of Germany, Austria, Belgium, United States and Great Britain, the latter including those of the Board of Trade, of the parish of St. Pancras, and of the Institution of Electrical Engineers; English reprints of the latter and those in Germany have already been noticed in the *Digest*.

Paper Cables. DOMINE. *L'Eclairage Elec.*, Nov. 6.—An abstract of an article from the *Annales Télégraphiques*, May-June. He gives in a table the length of such cables made in 1896; a new type containing 224 pairs is to be made this year; the total length of wires is 40,818 kilometres; the materials employed are always lead, copper, paper and a little cotton; it appears that all these are used by the French postal service.

Joints in Telegraph and Telephone Wires. DOBBS and NORTH. *Elec. Eng.*, Nov. 18.—An illustrated article in which they give the results of approximate measurements of the resistance of joints in telegraph and telephone lines, for the purpose of pointing out whether or not joints should be soldered. They mention two lines from New York to Boston, built in 1888 of copper wire, which showed only a trifling resistance beyond the theoretical amount, although 100 miles of it was not soldered at all; the tests, however, were made while the line was new. Telephone currents being alternating and infinitesimally small, and the line being dead when not in use, no increase of the resistance need be expected from those currents. They collected a lot of specimens of joints of all kinds, such as would be found in a plant which had been neglected to a certain extent, and from the results obtained they concluded not to solder any more joints except where copper and iron are joined together; they tested fifty samples, illustrations of some of which are given; the results of some of these tests and the descriptions of the joints are all given; the average resistance for a number 14 new iron wire made as examples of good joints was 0.015 ohm; similar joints, which had been in use a year or more, but had not yet begun to rust, gave 0.043; some old joints, the wire of which was so bad that it had to be taken down, varied very greatly; the average of seven specimens, including a very bad one, was 0.434 ohm; rusty ends should be cleaned before splicing, even though the strain on the line insures a good mechanical contact; other tests seem to show that the larger wires for telegraphic lines might to advantage be soldered; tests of hard copper joints were also made. In their conclusions they state that the average line in exchange work will not contain over ten connections, and this will increase the line resistance only 0.150 ohm, an amount which is too small to be considered in telephone work, even on long lines containing many more joints. The McIntyre joint showed a comparatively high resistance. In making joints with No. 12 to No. 14 iron wire they recommend making a long twist and then taking ten turns on each side of the twist; for the larger size five to six turns will suffice. If joints are soldered they should not be dipped, as that makes the wire brittle; they recommend using a heavy iron or blow torch; the solder should be applied only to the centre, in order to save injuring the wire.

Fuses vs. Circuit Breakers. HARRINGTON. SACHS. *Amer. Elec.*, Nov.—A continuation of the controversy on the relative merits of circuit breakers and fusible cut-outs. Harrington claims that the induced E. M. F. due to quick opening is amply taken care of in the case of circuit breakers by the flashing or arcing provided for at the jaws; carbon points provided for this purpose have the advantage both electrically and commercially of inserting resistances in the circuit in a far simpler and cheaper way than by using a rheostat, as suggested in a previous article. Another advantage of circuit breakers over fuses is claimed to be that they open more and more quickly as a current causing such opening increases; it is admitted that fuses below ten amperes' capacity are not objectionable, but above that the importance of using magnetic circuit breakers increases. Sachs considers that one of the advantages of the fuse is that its rapidity of action depends upon the square of the current flowing, while the action of the circuit breaker is only directly proportional to the current. He thinks that the instantaneous action of the circuit breaker is a disadvantage, while the fuse introduces a time interval which, in the enclosed fuse, may be varied between wide limits. He states that in a certain type of enclosed fuse all the variable factors incident to the open fuse have been eliminated.

Multiple Switch for Three-Wire Circuits. VAN DETH. *Amer. Elec.*, Nov.—An electromagnetically operated switch system is described, by means of which any number of switches can be operated from any one of a number of push buttons.

ELECTRO-PHYSICS AND MAGNETISM.

Practical Applications of the Coherer. BROWN. Lond. *Elec.*, Nov. 12.—An article in which he describes what will and what will not probably be the commercial uses of the coherer in the near future. Among the applications which are not likely to be found practical he mentions long distance wireless telegraphy, such as was shortly promised by the public press; variable atmospheric conditions appear to prevent the likelihood of this application, even if the sensitiveness of the apparatus could be increased; it is impossible to prevent a coherer from being affected by all electric waves in its vicinity if it responds to any of them; this shows that there can be no "syntony" in such systems, as has been claimed; the coherer will not pick out one signal from a simultaneous batch of three or four, and he does not think it likely that it ever will be made to do so, although it may have some selective power for short distances; moreover, atmospheric variations would alter the time period of the conductors; others means of selection must be found. He then discusses the applications of the coherer which may be useful; among these are ship signalling; this, however, would be of little use in time of war, as the enemy need only keep a transmitter continually going to entirely prevent intelligible signalling in the vicinity; also for military telegraphy, where again it is limited by the difficulties of simultaneous signalling; there is also difficulty in getting sufficient elevation of the collecting wires; he claims that the alleged fact that horizontal wires in the Marconi system were worse than useless, as distinguished from vertical, was the fault of the apparatus and not of the wires; by adopting suitable arrangements he (Brown) found that the coherer can be operated simply without tall conductors or high tension applications; the application for municipal telegraphy, as for fire alarms, police communications, etc., he believes to be the most important and immediately available; the description of his system which he appears to have worked out, is not given; as it is not possible to prevent the coherer from being affected by all electric waves, and as some means of tuning is necessary, he constructs the receiving instrument which the coherer controls, so that it is affected only by the particular rate of signals intended for it, thus giving the instrument a selective quality. It may be used for railway signalling on running trains; lightship connections can also be made without directly leading the cable to the ship; broken or disconnected submarine cables, if the ends be near each other, can also usually be signalled through by using a coherer; another large field of application is for relay purposes for ordinary telegraphy, and this forms a "most exquisitely sensitive" means of receiving exceedingly reduced currents which cannot be detected by the ordinary apparatus, including even a telephone; another very important application is the working through bare submerged wires or cables, and to this he has given considerable attention; it is based on the principle that the more sensitive the receiving instrument the greater the distance along such a wire at which the instrument will be affected; what the maximum distance will be it would be very costly to determine, but he thinks it may run into hundreds or several thousand miles.

Carbon Detector for Hertz Waves. JERVIS-SMITH. Lond. *Elec.*, Nov. 12.—A short article describing his experiments with a detector made of very finely pulverized carbon in a glass tube provided with terminals; he found that this was exceedingly sensitive to the slightest electrical disturbance; its resistance should be such that a small current can flow through it; it proved itself to be a very useful instrument; the effect of distant lightning was distinctly shown; a vacuum does not appear to improve the action.

History of the Coherer Principle. LODGE. Lond. *Elec.*, Nov. 12.—A long article giving the history of this instrument, beginning with 1850 and concluding with an explanation why metallic cohesion is caused under electrical influence. An editorial reference states that the sudden fall in resistance of metallic power during a thunder storm was observed by Varley in 1856.

Forms of Lines of Force Around a Hertz Radiator. GUTTON. *L'Eclairage Elec.*, Nov. 6; abstracted from the *Comptes Rendus*, 125, p. 569.—He determined experimentally the form of the electric lines of force in the Hertzian field.

Compressional Electric or Magnetic Waves. HEAVISIDE. Lond. *Elec.*, Nov. 12.—A highly mathematical article on compressional waves.

Retardation of Spark Discharge. WIREBURG. *Wied. Ann.*, No. 11; noticed briefly in Lond. *Elec.*, Nov. 12.—The encouragement of a spark discharge by ultra violet light is due to the shortening of the period elapsing between the establishment of the necessary voltage and the actual passage of the spark; this he found some time ago, and he now gives some further results; this period, which he calls the retardation, is diminished by moisture, by previous discharges, and is increased or diminished by a magnetic field according as it favors or retards a current proceeding from the positive to the negative electrode. He concludes that during the retardation a very feeble non-luminous electric current is passing.

Dielectric Constant and Electrical Absorption. DRUDE. Lond. *Elec. Eng.*, Nov. 12.—A brief abstract of a paper in the *Journal of the Chemical Society*, describing experiments made with a Hertzian oscillator.

Photo-Electric Current. ELSTER and GEITEL. *L'Eclairage Elec.*, Nov. 6; abstracted from the *Wied. Ann.*, 61, p. 445.—They discuss the relation

between this current and the angle of incidence, and the direction of the plane of polarization of the incident light to the absorption of the light by the cathode.

Electric Conductivity of Tri-Chloric Acetic Acid. Rivals. *L'Eclairage Elec.*, Nov. 6; abstracted from the *Comptes Rendus*, 125, p. 574.—The results of measurements of the conductivity of various solutions of this acid.

The Phenomena of the Capillary Electrometer. Behn. *Zeit. f. Elektrochemie*, Nov. 5; abstracted from the *Wied. Ann.*, 61, p. 748.—He endeavors to give an experimental proof of the theory.

Voltaic Action of the Proximity of Substances. Gore. Lond. *Elec. Eng.*, Nov. 12.—A brief reference to a recent Chemical Society paper. He shows that a difference of pressure due to gravity at the upper and lower ends of a vertical column of electrolyte about three metres high on similar electrodes produced a very feeble current; similar effects should therefore be produced by the gravitation of action of a large mass of metal on an electrode in a horizontal column; experiments confirmed this.

Effective Value of Alternating E. M. F. Barnett. Lond. *Elec.*, Nov. 12.—A description of a method of deducing the effective value of an alternating wave of current or E. M. F. which he devised and believes to be new; it is claimed to be extremely general, besides being simpler and briefer than the others, and that it can be readily understood by anyone having a knowledge of trigonometry.

Electric Resistance of Metals. Liebenow. *Zeit. f. Elektrochemie*, Oct. 20 and Nov. 5.—A very long article in which he endeavors to show that what takes place in the solid metals is as though thermo electromotive counter forces tend to prevent the rapid movement of electricity in these conductors; in this way he endeavors to explain the phenomena of electric resistance; he shows that this hypothesis explains not only reversible thermic actions in metallic conductors but also those which are not reversible; it also explains the great increase of the specific resistance which often occurs by mixing two metals. The article is mathematical in character; he starts with the discussion of thermo-piles consisting of elements of infinitely small length, and then discusses alloys, the temperature coefficient, the resistance of pure metals, etc. In conclusion he urges that more extensive data should be obtained and suggests that it may be possible to make a metal of the ordinary metals which should have the properties of a noble metal; also that there may be combinations of metals which in their pure state conduct better than silver or copper.

Action of X-Rays on Cutaneous Evaporation. Lecercle. *L'Eclairage Elec.*, Nov. 6.—A brief abstract of an Academy paper giving the results of experiments in which which he measured the amount of water evaporated from the skin before it is exposed to the rays, immediately after, and an hour and a half or two hours afterwards; he found that it produced a diminution of the evaporation which persists for a long time afterwards, and can even result in the complete suppression of the evaporation. This is followed by an abstract of another paper in which he describes similar experiments made on the heat radiation; they show that there is always an increase in the heat radiation which persists for a long time after the exposure; he also observed in some cases a temporary diminution of the heat radiation.

Radiographs. Seguy. *L'Eclairage Elec.*, Nov. 6.—A brief abstract of an Academy paper. In a recent paper Porcher claimed that there was nothing gained by photographing the fluorescent image; the present author, however, obtained different results; he made a radiograph of the thorax in 30 seconds; it appears that he used two fluorescent screens, one on each side of the very thin glass plate containing the sensitive film; the image was complete and very sharp. This is followed by a brief abstract of another paper by the same author; he made the bulb of glass which contained powdered albumen and carbonate of calcium, or, better, the chloride of didyme; this has the property that the fluorescent image is red and not green; it emits twice as many X-rays as the ordinary glasses; the image on the fluorescent screen is more brilliant, and is of a greenish yellow with a red tint.

Deflection of Cathode Rays by Electric Oscillations. Schmidt. *Elek. Zeit.*, Nov. 4.—An abstract of a recent paper describing experiments. A very long tube was used with a fluorescent screen in the interior of one end and a diaphragm in the middle of the tube. Deflections were produced in the beam by merely touching the tube on the outside, the bright spot on the screen becoming oblong; similar results were produced with strips of tin foil on the outside of the tube, or with a metal ball connected with the cathode terminal, when the spot became a bright band. He is convinced that the repulsion is due to the oscillations rather than to the electrostatic charging.

Mutual Influence of Cathode Rays. Bernstein. *Wied. Ann.*, No. 11; abstracted briefly with some illustrations in the Lond. *Elec.*, Nov. 12.—He made experiments with the apparent repulsion of cathode rays and obtained results which do not agree with Crookes' interpretation; he favors some kind of wave hypothesis; two opposite beams running parallel, side by side in the same tube, did not affect each other, but when the cathodes were placed side by side and the beams went off in opposite directions they were bent; the direction of the emerging waves is therefore of no account; the action is probably exerted by one cathode on the beam of the other at its origin.

Cathode Ray Colorations. Abegg. *Wied. Ann.*, No. 11, noticed briefly in the Lond. *Elec.*, Nov. 12.—He made experiments which invalidated the chemical hypothesis concerning the colorations of salts by cathode rays, noticed by Goldstein.

Dissipating a Positive Charge. Schmidt. *Wied. Ann.*, No. 11, noticed briefly in the Lond. *Elec.*, Nov. 12.—There is a prevalent belief that there is a connection between the dissipation of a negative charge under the influence of light, and the corresponding acquisition of a positive charge; in the present article he shows that this is not so; his experiments were made with fluorspar and selenium.

Electromagnetic Shielding. Russell. Lond. *Elec.*, Nov. 12.—An article of a theoretical nature on the electromagnetic phenomena, in connection with the shielding exercised by iron, of a magnetic field from one or more conductors. He discusses the forces acting on coils, portions of which are shielded, and shows that when a conductor carrying a current is shielded from an external field the force that would otherwise have been experienced by the conductor is transferred to the shield in proportion to the shielding; he shows how this may be illustrated by a simple experiment. Referring to a recent article by Du Bois (see *Digest*, Sept. 11), he agrees with him that the principal force is exerted on the iron cylinder, but he does not agree with the deduction that a ring magnet experiences a side thrust when in an external field whose lines of force are in the same plane as the ring; this deduction is negatived by experiments which the present writer describes. When an iron tube, ring or other structure shields more or less perfectly a uniform external field from the conductor, then the conclusions which he draws are summarized as follows: If only the shield be moved the induced voltage is of the same sign as that induced if the current had been in an unshielded field, and is such that if a current result the motion of the field is opposed, and the induced voltage is proportional to the velocity with which the attenuated field cuts the conductor; if the conductor alone be moved the induced voltage is proportional to the velocity at which it cuts the attenuated field; if both shield and conductor be moved in the same direction the induced voltage is the sum of those induced when the shield and conductor are moved separately, and if a current result the motion of the shield and conductor are opposed; the sum of the voltages is the same as if the conductor had been moved in an unshielded field; if the conductor be carrying a current the magnetic thrust that would otherwise have been exerted between the conductor and the field is transferred to a magnetic thrust between the shield and the field in proportion to the shielding; if the shield moves, a back E. M. F. is induced; if the conductor be carrying a current the magnetic thrust is exerted between it and the field so far as it is unshielded; if the conductor moves a back E. M. F. is induced; if the conductor carries a current and forms a rigid system with the shield the total force is the same as if the conductor had not been shielded, but the thrusts are borne by the shield and conductor respectively in proportion to the fields in which they are; if the rigid system moves the induced voltage is the same as though there was no shield; lastly, that the shielding is a function of the permeability. The above deductions are claimed to be in harmony with the usual elementary conceptions of the known laws of electromagnetism. He suggests that a motion of this kind could be turned to some practical use; if an external field is maintained by a solenoid in series with a shielded wire it might form a delicate instrument for measuring alternating currents; as the shielding is a function of the permeability, an instrument was made with which he drew inverted B H curves; another instrument might be made to weigh the forces depending on the permeability of the iron, thus making a balance by means of which the permeability is weighed in terms of the current; in this way a sample may be compared with a standard; when excited by an alternating current the permeability can be determined under the practical conditions of working.

Pull of Electromagnets. Reithoffer. *Zeit. fuer Elek.*, Oct. 15.—A short article of a mathematical character, showing how the Maxwell formula for the pull of an electromagnet may be calculated in a more simple way; he shows that the theory of the lines of force leads to the same formula in a very simple way. He assumes a U-shaped electromagnet, and that the armature is moved an infinitely small distance from the magnet; this will reduce the number of lines of force, but this is to be prevented by increasing the current; by moving the armature this distance the energy in the system is increased, and from these relations he deduces the well-known formula. A similar deduction made by Vogelsang was referred to in the *Digest*, Sept. 18; the present writer, in referring to this, shows that a certain element was forgotten, and that, therefore, Vogelsang's results are not correct. He also claims that Natalis in his criticism (see *Digest*, Oct. 2) overlooked something and, therefore, did not come to correct conclusions.

Ferro-magnetic Properties of Iron and Steel. Fleming. Lond. *Elec.*, Nov. 12.—The conclusion of his recent lecture (see *Digest*, last week). He continues the discussion of the constitution of the iron molecule and shows how various properties of the iron may be explained according to his hypothesis: large permeability denotes ease of colineation of the molecule; the difference in electric resistivity and temperature coefficients for various iron compounds are also discussed.

Magnetic and Electrolytic Conductivity. Milani. *Nuovo Cimento*, Sept.; noticed briefly in the Lond. *Elec.*, Nov. 5.—Neesen announced some years ago that a strong magnetic field is capable of modifying the conductivity of a solution of ferric chloride; the present writer repeated the experiments, but found that this was not true.

Permanent Magnets. CHISTONI and DE VECCHI. *Nuovo Cimento*, Sept.; noticed briefly in the Lond. *Elec.*, Nov. 5, whose abstract is reprinted in *El'ty* (New York). Nov. 17.—They made tests of Valtroupia tungsten steel as regards permanent magnetism and high permeability; the results are superior to those obtained by Barus and Strouhal; the results are not given in a tangible form in the abstract.

Interpretation of the Zeeman Effect. CORNU. *L'Eclairage Elec.*, Nov. 6.—A short article interpreting this phenomena so as to leave no doubt as to the conclusions announced by its discovery; at present it is claimed that confusion has arisen, which is due to faults in the observations. He concludes that "the action of the magnetic field on the emission of a radiation tends to decompose the vibratory rectilinear components capable of being propagated by waves following the circular vibrations parallel to the currents in the solenoid"; also that "the vibrations which turn in the direction of the current of the solenoid are accelerated, and those which turn in the opposite direction are retarded." This interpretation shows that the phenomena may be explained independently of the electro-chemical ideas of Lorentz; it also shows the difference between this phenomena and the rotary magnetic power discovered by Faraday. It is followed by a ong appendix on the methods of observation.

Interpretation of the Zeeman Experiments. GARBASSO. *L'Eclairage Elec.*, Nov. 6; abstracted from the *Nuovo Cimento*, July.—He claims that unsurmountable difficulties are encountered in applying the theories of Lorentz to the experiments of Zeeman, and he offers another explanation which is quite different.

Action of Magnetism on Light. KALISCHI. *Elek. Zeit.*, Nov. 4.—A brief discussion of some recent publications on the phenomena recently discovered by Zeeman.

High Magnetic Quality of Steel. JACKSON. *Eng. News*, Nov. 18.—A brief communication referring to a recent article in that journal. He speaks to Ewing's test of the magnetic quality of what is known as Allen steel which shows it to be superior to any steel casting made commercially in this country; this high magnetic quality is apparently due to the unusually small percentage of impurities and to the unusual soundness of the castings. Although the present writer has made tests of castings made by a large number of American manufacturers, none of them equalled the Allen steel in magnetic quality or chemical purity. The article he refers to was published in that journal Nov. 4. and refers to the Tropenas process of making steel which is used by the Allen Company at Sheffield, England; the steel referred to it appears is made by that process; Ewing stated that it formed an exceptionally good material for dynamo magnets; a description of the progress from the patent specifications is given, the principal feature being that he avoids agitation of the metal in the converter, the blast being always above the surface of the metal.

Inductance.—Amer. Elec., Nov.—An example is solved to illustrate the principle of inductance; a choke coil is first connected on a continuous-current circuit and the ohmic drop thus determined; it is then connected to an alternating current circuit of a known frequency and the voltage at the terminals noted. With these data the coefficient or self-inductance is calculated step by step, with accompanying explanations of the principles involved; other examples are worked out to illustrate the principles of inductance.

Relations of Light and Electricity. CHANT. *Can. Elec. News*, Nov.—An article on "Light, a Branch of Electricity," in which he claims to show the intimate relation between radiant heat, light and electricity; it is limited to an elementary discussion of Hertzian waves.

Electrical Catechism.—Amer. Elec., Nov.—The current installment of this serial is on the angle of alternating current lag.

ELECTRO-CHEMISTRY AND BATTERIES.

Electro-chemical Progress. BLOUNT. Lond. *Elec.*, Nov. 12.—An article discussing recent progress and pointing out the direction of development. He considers that the most important recent achievement is the conversion of the capitalist, as money may now be secured for development in these directions; the number of quack inventors is also growing less. The most flourishing branch of the industry is the refining of copper; it is different, however, with the electrolytic reduction of copper from its ores; electrolytic refining of zinc is not practiced and is not likely to be undertaken, but the electrolytic reduction of zinc from its ores offers many advantages, and at least one process is paying very well; nickel may now be deposited in thick layers by heating the solution, but the deposit is not particularly pure and there is no great advantage over the ordinary dry process; the aluminum industry is on a firm and broad basis; sodium can be made cheaply, but wants buyers; soda and chlorine products are just rounding the corner, and their manufacture is being seriously undertaken; he maintains a discreet reserve regarding calcium carbide; there has been much solid progress, and substantial advances in electro-chemistry may be looked for in the near future.

Laws of Alternating Current Electrolysis. MALAGOLI. *L'Eclairage Elec.*, Nov. 6.—Since publishing his theory on this subject he has made a number of experiments which confirm what he said on the shifting of the phase between the voltage and the current; he also made experiments to determine the quantitative laws, and in the present article he gives the results of these observations. He concludes that for the same electrolyte, even at different degrees of concentration, the electrolytic power of the current is constant in a circuit containing numerous voltameters, provided that the active surface of the electrodes is equal in all, even though the distance between the electrodes may be varied in the different voltameters; in every case, other conditions being equal, the quantities of gas obtained are proportional to the time during which the current passes; the quantity of the electrolytic products of the electrolysis is proportional to the intensity of the current, or better, to the number of coulombs, provided that the intensity upon the electrodes in the different voltameters is constant; the quantity of the electrolytic products obtained in different voltameters through which the same current passes is composed of the electro-chemical equivalents of the electrolytes and of the difference between the quantity of electricity which traverses the circuit during every half period and double that which is necessary to saturate the electrodes; this latter law replaces the analogous law of Faraday for continuous current. The formula which he gave before will therefore also explain these results.

Accumulator Construction. FITZGERALD. Lond. *Elec. Eng.*, Nov. 5 and 12.—In this continuation of his serial he discusses the Planté process, and in the latter installment he describes a method of testing the presence of oxidized agents in the electrolyte by means of ferrous sulphate; another paragraph refers to the Planté process, in which it is stated that he considers it doubtful whether any process has yet been suggested for obviating the expenditure of time and energy in the Planté process which could safely be adopted. He describes the method of making a porous layer on the lead plate by means of dilute nitric acid, and shows the great difficulty of getting rid of the nitric acid in the plate; for this he suggests as a remedy to decompose the oxides of nitrogen by ammonia and heat; the acid may be purified by adding sulphate of ammonia and heat until it fumes strongly and ceases to give off any gas, the oxide of nitrogen being thus decomposed, evolving nitrogen gas; for plates, saturate them with a weak solution of sulphate of ammonia and heat to 600° F. (which is only 18.8° F. below the fusing point of the lead).

New Accumulator. TOMMASI. *Zeit f. Elektrochemie*, Nov. 5; abstracted briefly from a French journal.—The plates consist of a frame of antimony and lead, filled with active material, enclosed in perforated sheets of celluloid, the metallic frame serving only as a conductor; the capacity is 22 to 25 ampere hours per kilogram of active material; nothing is said of the internal resistance.

Mechanical Theory of Electrolysis. WEYDE. *Elek. Zeit.*, Nov. 4.—An attempt to explain electrolysis by mechanical analogies, based on the Maxwell hypothesis; diagrams are given; it does not admit of being abstracted. He assumes that a liquid contains molecules which are made of two kinds of atoms, conducting and non-conducting; the migration of ions he claims may be explained in a very simple manner by this method.

Electrolytic Decomposition of Solutions. NERNST. *Zeit. f. Elektrochemie*, Nov. 5; abstracted from the *Berl. Ber.*, 30, p. 1547.—A discussion of electrolysis from the standpoint of his dissociation theory and the osmotic theory of the generation of currents.

Currents Passing Through Electrolytes. DANNEEL. *Zeit. f. Elektrochemie*, Oct. 20 and Nov. 5.—A long article on what he calls the "Reststrom," by which he means the current between two insoluble electrodes due to a low E. M. F., and which Helmholtz called convexion currents. The first part is theoretical in character; in the second part he describes experiments. His conclusions are that these currents depend on the E. M. F. and the concentration of the dissolved materials; the absolute values, however, are in general larger than those required by theory.

Solutions of Alum. JONES and MACKAY. *Zeit. f. Elektrochemie*, Nov. 5; abstracted briefly from the *Amer. Chem. Jour.*, 19, p. 83.—They give the results of measurements with the electrolysis of some alum solutions, in order to determine whether they are complex salts or double salts; in concentrated solutions they appear to be double salts.

Cadmium Solutions. GORDON. *Zeit. f. Elektrochemie*, Oct. 20; abstracted briefly from the *Zeit. Phys. Chem.*, 23, p. 468.—He showed the dependence of the amount of cadmium, transmitted in solutions, on temperature.

Production of Chromium. ASCHERMANN. *Zeit. f. Elektrochemie*, Oct. 20.—A brief description of his process, which is well spoken of editorially; metallic chromium is produced in an air-tight electric furnace of cast iron.

Oxidation of Nitrogen. RAYLEIGH. *Zeit. f. Elektrochemie*, Nov. 5; abstracted briefly from the *Jour. of the Chem. Soc.*, 411, p. 181.—He describes experiments made to oxidize nitrogen by means of electric discharges; in one hour 21 liters of gas were oxidized at the rate of about "25 cubic meters per watt hour" (?); by this means he obtained argon nearly free from nitrogen.

Rhodin Electrolyzer. KERSHAW. Lond. *Elec.*, Nov. 12.—A communication in which he warns against the investment of money in this apparatus (see *Digest*, Nov. 13, also Nov. 27), which in his opinion, and also in that of many others, has not yet been sufficiently tested.

German Electro-Chemical Society.—L'Eclairage Elec., Oct. 30.—A continuation of the account of the recent meeting, giving abstracts of the papers, all of which have already been noticed in the *Digest*.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Testing Meters. Schuchardt and Jones. *L'Eclairage Elec.*, Nov. 6.—A description of what is claimed to be an original method for testing meters which contain motors; it seems to consist simply in passing a constant current through it and counting the number of revolutions per second; the method is said to be a very exact one; some of the results are given for the Thompson, the Shallenberger, the Duncan and the Diamond meters.

Measuring Instruments.—See latter part of the abstract of Russell's article on electromagnetic shielding.

Insulation and Cable Testing. Hopkins. *Amer. Elec.*, Nov.—Methods of testing porcelain glass insulators for high voltage work are described and illustrated. A voltage of 40,000 applied for a period of forty minutes is recommended for porcelain insulators whose walls are at least 1 inch in thickness, and 30,000 volts for the same period of time for insulators with walls one-half inch thick; insulators remaining intact may nevertheless become highly heated while under test, in which case they should be condemned. A spark gap is used in the testing circuit, being set at 1 1-2 inches for 30,000-volt test on an average day. Instead of the ordinary dry test he recommends a wet test, which is described and illustrated. Two methods of cable testing are suggested, one being a dry and the other a wet method.

Primaries of Induction Coil.—Amer. Elec., Nov.—It is recommended that in the primary of an induction coil the largest current possible and the least number of turns possible be employed; the ampere-turns being the same the secondary will enclose the same number of lines of force with a large or small number of turns of the coil; in the former instance, however, the larger inductive E. M. F. will give a longer spark, thereby prolonging the discharge of the primary and secondary, and consequently reducing the secondary E. M. F., besides setting up injurious sparking; to adjust the primary to a given voltage non inductive resistance should be used in the external circuit. The utility of the condenser in connection with a properly designed primary is doubted.

Ammeter Shunt. Sheldon. *Amer. Elec.*, Nov.—A shunt is described which permitted the readings of a 750-ampere Weston instrument to be divided by 100, thus giving a range of 7 1-2 amperes by 1-20 ampere divisions; it consists simply of a strip of German silver, 5-8 inch wide, .015 inch thick, and about 6 inches long.

Wheatstone Bridge. Hobart. *Amer. Elec.*, Nov.—The second installment of an article describing the construction of a cheap form ot Wheatstone bridge.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Marconi Telegraph. Pouchain. *Elek. Zeit.*, Nov. 4.—A German translation of his report on recent experiments, published in *Rivista Marittima.*

Wireless Telegraphy.—See abstract under "Coherer," by Brown.

Automatic Telephone System.—Zeit. fuer Elek., Oct. 15.—A brief, illustrated description of the Pierard system, especially adapted for small installations in a building; for n stations there are $n + 3$ wires, including n for calling, one for conversing, one for the battery and one for the return circuit.

Development of Multiple Systems in Large Telephone Central Stations. Hellrigl. *Zeit. fuer Elek.*, Nov. 1.—The first part of a long article of a general character describing the development of these systems.

Cable from England to Australia.—Lond. *Elec.* and *Elec. Eng.*, Nov. 12.—Some notes on the proposed British cable around the Cape of Good Hope.

Polarized Relay. Willot. *L'Eclairage Elec.*, Nov. 6.—An illustrated description of his relay, which is a modification of his older one and is characterized by the combination of two permanent magnetic fields, the distribution of which is varied by the current.

American Telephone Practice. Miller. *Amer. Elec.*, Nov.—The current installment of this serial is devoted to the description and illustration of listening and ringing apparatus for switchboards.

Telegraphs and Telephones in Persia.—West. Elec., Nov. 20.—A reprint of a consular report.

MISCELLANEOUS.

Diagram Accounts for Engineering Work. Jameson. Lond. *Elec. Eng.*, Nov. 12.—A brief abstract of a recent paper read before the Institution of Mechanical Engineers, in which he shows the advantages of keeping accounts in the form of diagrams; among other advantages he states that from such lines may be deduced a closely approximate line pointing directly to a graduated scale of greater or less profit or loss; the abstract is only very brief, and the paper is well spoken of editorially.

Connection of Lightning Rods to Gas and Water Mains.—Elek. Zeit., Nov. 4.—A reprint of the official rules and regulations in Berlin.

Netherlands Society of Electrical Engineers.—Elek. Zeit., Nov. 4.—A brief account of the history of this society, which was formed in 1895; some of the papers are mentioned, but not abstracted.

Electricity Direct from Heat. Coxe. *Elec. Eng.*, Nov. 18.—A note referring to his recent paper read in Boston, describing his thermopiles. He claims that one of 1-hp capacity will furnish current for ten 16-cp lamps, and will cost only 1 cent per hour; he would not undertake to build a machine of a larger capacity than 250 lamps, but if constructed he claims that it would be more economical than existing plants of like capacity.

Electricity Direct from Heat. Deprez. *West. Elec.*, Nov. 20.—A translation of his recent French Academy note, which was noticed in the *Digest*, Nov. 6.

Locating Cash Carriers Magnetically. Harrold. *Amer. Elec.*, Nov.—Three pieces of magnetized clock spring are riveted to the sides of the leather cash carriers; when the carrier becomes stuck it is located by means of a compass.

An Improved Enclosed Arc Lamp.

The advantages of enclosed arc lamps are so well known and have been so often described that it is not necessary to again enumerate them. These lamps are, however, being constantly improved upon, and one of the latest types is illustrated and described herewith. The lamps, designed for indoor and outdoor use, are shown in the illustrations. In lowering the outer globe to trim the lamp the lower carbon holder, to which the inner globe

New Enclosed Arc Lamp.

is rigidly clamped by a spinning, is securely held in a socket on the frame of the lamp, but it may be instantly detached, bringing with it the inner globe and lower carbon. This, it is claimed, makes the lamp one of the easiest and quickest to trim, and reduces the breakage of inner globes to a minimum, at the same time admitting of perfect alignment of the carbons. The outer globe holder screws into the bottom frame of the lamp, and not only forms a rigid support for the globe, but permits standing the lamp on end during installation or at any time when it may be necessary to take it down.

The mechanism of this lamp, as shown in the illustration, is extremely simple. There are no gear wheels, pinions or springs. The magnets are firmly held at both ends, and two large dash pots maintain a steady arc without flickering or jumping. The clutch is firm, yet sensitive, and gives an almost imperceptible feed. There are no sliding contacts on the rack rod, the current being supplied to the upper carbon by a flexible cable.

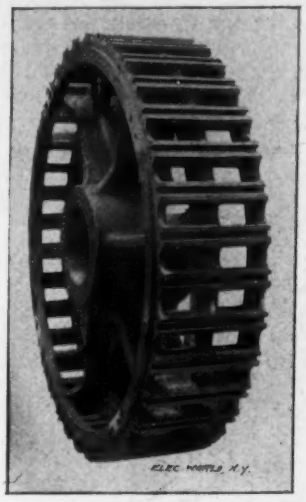
The quality and quantity of the light may be varied by using different combinations of globes. Light alabaster inner and outer globes give the greatest quantity of soft white light, but inner globes of denser alabaster can be furnished, if desired. These dissipate all shadows, but reduce the amount of illumination more than the light globe.

The ornamental lamps are furnished in a number of special finishes, including oxidized brass, dull brass with black bands, antique copper and gold lacquer. These finishes are given when specially ordered, the regular ornamental lamp being finished in polished brass only.

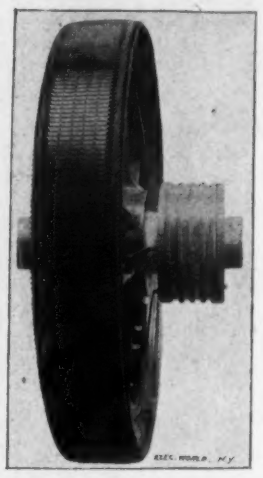
All indoor lamps, whether ornamental or plain, are equipped with a switch for turning the current on or off. The standard lamps consume five amperes of current. These lamps are manufactured by the Diehl Manufacturing Company, Elizabethport, N. J.

The Construction of Engine Type Alternators.

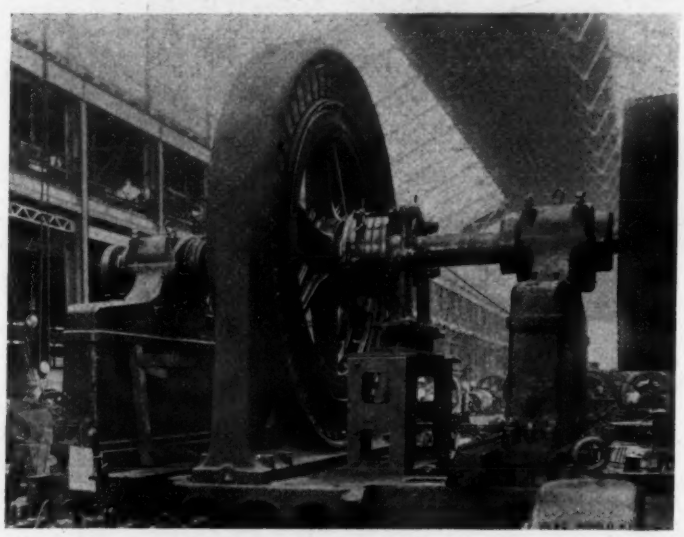
Illustrations are presented herewith of a number of parts of large polyphase generators recently built by the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., and representing its latest type of construction. These generators are of the so-called engine type; that is, are made with a stationary field and revolving armature adapted for direct coupling to engines in the manner now becoming almost universal. In these machines the field ring is made of cast iron, the poles being made of laminations bolted together between steel face plates and cast into the metal of the supporting ring. The rings are divided vertically in an axial plane. By this construction ,the magnetic qualities of the field are greatly enhanced and an almost complete elimination of eddy currents is secured. The frames containing the field coils are of iron and are provided with lugs to receive the bolts which secure them to the frame of the machine. By the vertical division of the field, which is mounted on a sliding base, the two halves can be separated to an extent sufficient to allow the replacing of field coils, or even the removal of the armature.



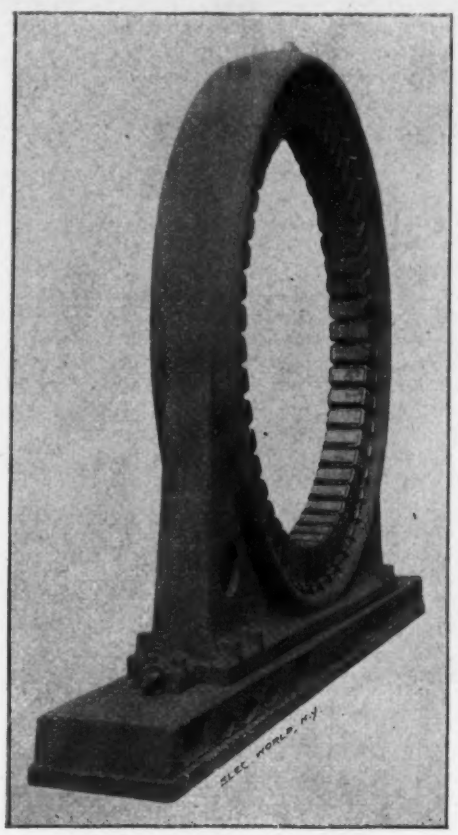
300-KW ARMATURE SPIDER.



300-KW TWO-PHASE ARMATURE.

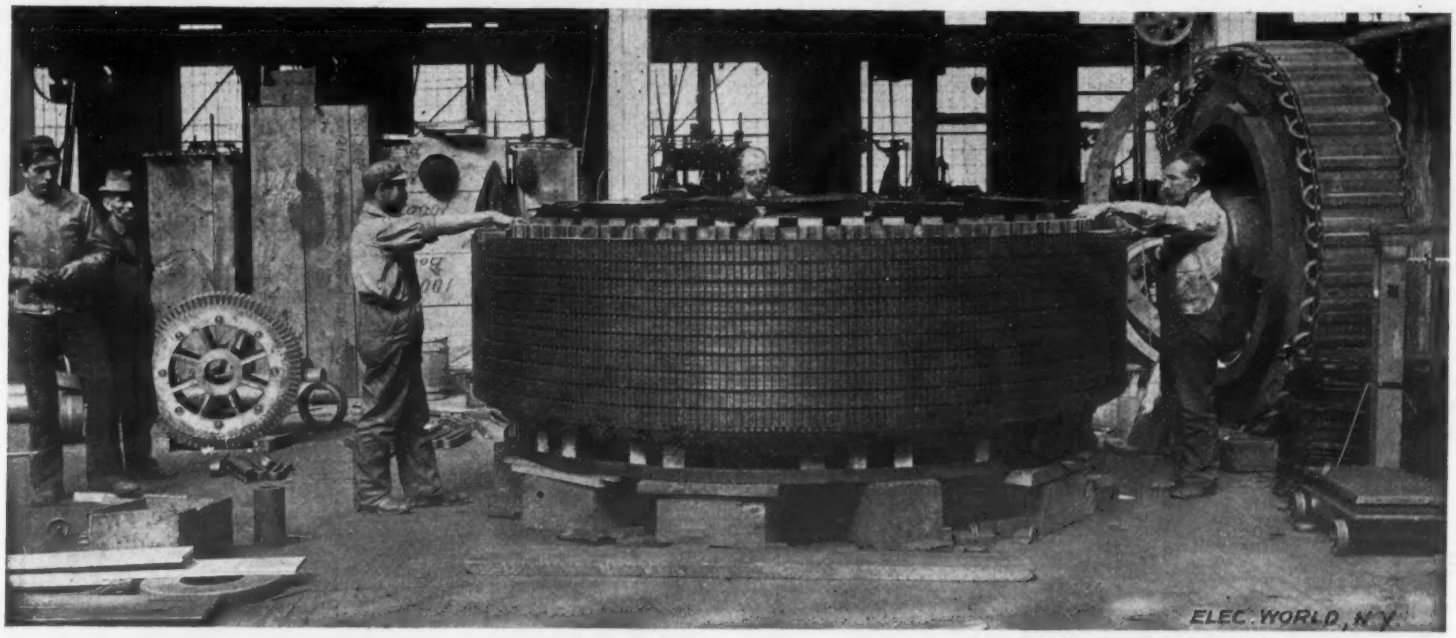


TESTING A 300-KW TWO-PHASE GENERATOR.



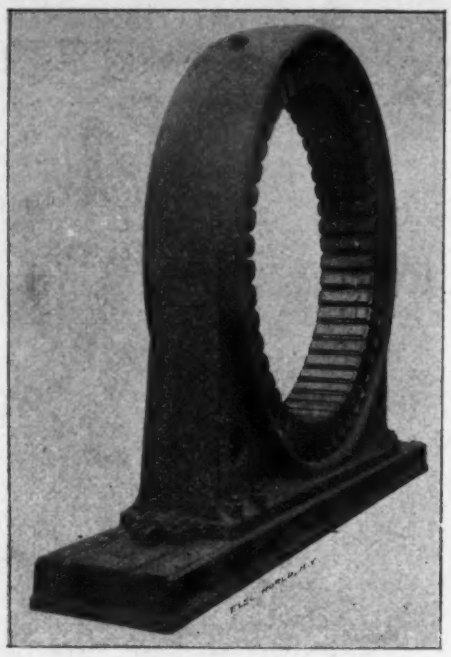
300 KW FIELD FRAME.

The armature is constructed upon a cast-iron spider, which is shown in one of the illustrations. The slots in the teeth of this spider are milled into the dovetailed shape shown in the illustration for the reception of corresponding projections upon the under side of the laminæ, which compose the working surface of the armature. These are thin steel punchings, which extend over from two to three slots, according to the size of the armature. In assembling the armature it is laid on its side, as shown in the illustration, and these are put on one above another, the joints of each ring of punchings being made to lap those of the ring next to it. At convenient intervals a cast brass separating ring is put in, this being provided with openings so constructed that it acts as a centrifugal blower when the machine is in operation, forcing a current of air through the laminated iron parts of the armature and over the working conductors, and



ASSEMBLING A 1200-KW TWO-PHASE ARMATURE CORE.

greatly aiding in keeping the whole structure cool. When the punchings have been assembled in place they are subjected to great pressure, and are finally bolted up between steel end plates. In all of this class of machines a type of bar winding is used, with end connectors, which are both screwed and soldered to the working conductors. The collector rings are of very massive construction, and are insulated with a compound containing a large amount of mica.



500-KW FIELD FRAME.

The mounting of the armature upon the engine shaft is generally accomplished by boring it to a slight taper corresponding to a similar one on the engine shaft, and forcing the two together by hydraulic pressure. This does away with the risk of springing the armature out of true with a key. On all these machines self-oiling bearings are used, oil rings working in a chamber under the bearing supplying the necessary distribution of lubricant.

In the illustration shown herewith there are represented two two-phase generators of 500 and 300 kilowatts respectively, adapted to give 2200 volts, and built to be operated in parallel.

Steam and Oil Separator.

The removal of moisture from live steam and the oil from exhaust steam constitutes a problem of no mean magnitude, and one which every engineer has in his experience to meet in a greater or less degree. That both should be removed is a necessity that is conceded by all engineers, but how to accomplish the results is where the practical difficulties lie.

Different natural laws of separation have been laid hold of by different manufacturers, but probably the latest conception of the problem is embodied in the Bundy separator, which, broadly speaking, is a capillary separator. It is a wide departure from all previous constructions.

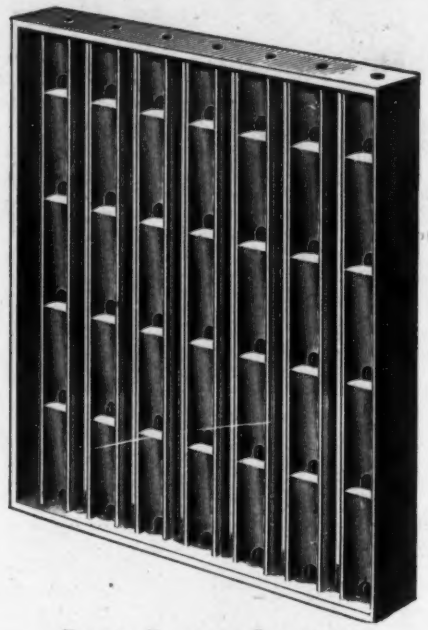
By reference to the accompanying cut it will be observed that the Bundy

STEAM AND OIL SEPARATOR.

separator consists of a nest of upright baffle plates placed directly in the passageway of the steam, and at right angles to it, and having a receiver underneath. In operation it takes advantage of the natural tendency of water and oil to cling to any obstructing surface. The steam strikes the flat front of each upright baffle, which has a series of receding hollows, sloping downward, and terminating in the small hole leading to the main artery or capillary for the safe conduct of the water or oil to the receiver.

Immediately back of the space in the front baffle plate comes the upright of the second plate, and so on through all of them. They are set staggered to each other, with, however, plenty of area for the steam to pass through to the engine. The main advantage claimed by the makers of the Bundy separators is the fact that when once separated there is no possible chance for the water or oil to again be picked up by the steam. The water and oil is immediately conveyed to the enclosed passageway, through which it flows downward to the receiver.

Perhaps the first question that suggests itself to the reader is whether the placing of these baffle plates directly in the passageway will not diminish the pressure of the steam, but the manufacturers claim not. They have tested



BAFFLE PLATE OF SEPARATOR.

them in many different ways, and guarantee that the steam pressure will remain the same, and that there will be no "wire drawing" of the steam.

A late example of the application of the Bundy separator is in the power house of the New York and Brooklyn Bridge, where two 10-inch separators are in use. They were sold under a guarantee to deliver 99 88-100 pure dry steam, and upon completion fulfilled the guarantee by passing the test imposed.

The water in the receiver may be returned to the boiler automatically with a Bundy return trap, or wasted away as fast as it accumulates, with a Bundy tank trap.

The Bundy separators are made by the A. A. Griffing Iron Company, Jersey City, N. J.

Decorative and Miniature Lamps.

The decorative and miniature incandescent lamp industry has developed to such an extent in late years as to specialize this class of work as a distinctive branch of the art of lamp making. The demand for lamps of this class is a constantly growing one, and in order to meet it and anticipate the wants of this trade, capital, skill and energy are being duly employed.

One of the most thoroughly equipped plants for the production of this class of goods is that of the American Endoscopic Company, of Providence, R. I. Here are manufactured surgical lamps, dental lamps, series lamps, and candelabra lamps.

In the manufacture of surgical instruments to illuminate all the cavities of the human body, it is, of course, absolutely necessary to use none but the

FIG. 1.—THEATRICAL LAMP.

finest material, combined with skill. The lamps produced for this purpose by the Endoscopic Company are claimed to be unsurpassed, and the company, it is stated, has given much time and spared no expense to the fitting up of its lamp department, in order to produce the best results. The company, recognizing the general demand for low-current lamps, is making a style of lamp suitable for use with dry-cell batteries, and claims that these lamps may be depended on in such use.

The new metallic filament used by the company in its lamps is claimed to be a distant advance in the art of lamp making. The lamps are exhausted by

mercurial pumps, and the vacuum thus produced is guaranteed to be extremely fine.

Some idea of the variety of lamps made by the company may be gained from the following partial list: Cystoscope lamps, surgical lamps, pea lamps, dental lamps, special bicycle battery lamps, telephone lamps, and theatrical lamps. The new theatrical lamps for battery or series lighting are provided with unbreakable wire terminals, as shown in the illustration, Fig. 1. These lamps are designed to avoid short circuits, breakage and other defects in the old styles of lamps, also to facilitate easy attachment to any fabric. The lamp is inserted or attached to a fabric as one would insert a collar button in a button hole.

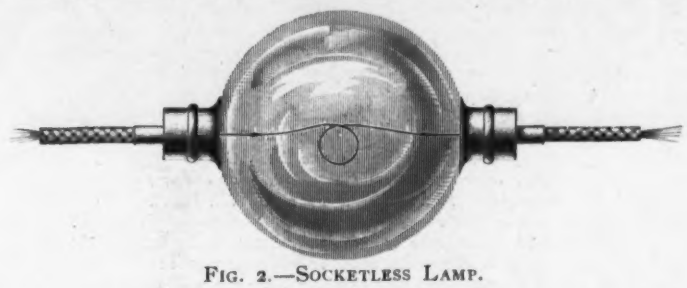


FIG. 2.—SOCKETLESS LAMP.

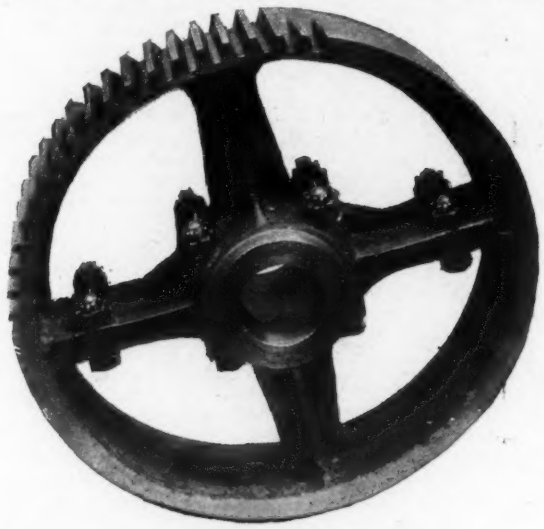
Fig. 2 represents a lamp which requires no socket or receptacle. It is designed for window decorations, Christmas trees, or other decorative purposes.

A Modern Gear Plant.

The astonishing growth during recent years of the electric street railway industry has led to an equally rapid development in the manufacture of gears for use with railway motors. Railway motor and motor gear and pinion are coeval, but during the life of the motor many sets of gears and pinions are necessary. To-day, when the number of motors in use reaches well toward the hundred thousand, the demand for gears and pinions is enormous, and at no time in the past has it reached its present proportions. A mild estimate places the number of electric railway motor gears in daily use in the United States alone at 50,000, at least, and as the average life of the gear is about two years, a yearly output of from 20,000 to 30,000 is necessary for renewals alone, exclusive of those required for new motors.

In the pioneer days of the electric street railway the cast-iron gear and pinion of gun-metal were used exclusively. Experience and time necessarily brought about improvements and changes. To-day the standard motor gears are of cast steel and the pinions are of hammered steel, while the teeth are accurately cut from the solid stock by machines as perfect in their adjustment and performance for their work as those which cut the more delicate gears of higher class machinery. The change from cast iron to steel has resulted in a reduction of some 60 to 70 pounds in the weight of the gears, while their life has been very materially increased. A steel gear will wear more than twice as long as a cast-iron gear, and while with the latter type breakage was a common occurrence, with the steel gear breakage is practically unknown.

To supply gears which would carry in themselves a guarantee of perfection, the General Electric Company established some time ago, at its River Works, Lynn, Mass., a plant for the manufacture of gears and pinions. This plant is a model of its kind. The cutting machinery is of the most modern character, and the entire plant is laid out on a comprehensive scale. It includes an extensive foundry for the gear blanks, as well as the gear-cutting shop. The former is equipped with overhead traveling cranes, driven by electric motors, furnaces for the molten metal, core ovens, and modern appliances of all kinds for the manufacture of steel castings of the highest grade. The great difficulty encountered in making steel castings—the tendency to form blow holes, draws and cracks—has been overcome in this foundry. After a long series of experiments the General Electric Company perfected a process which now enables the foundry man to produce steel castings which are as practically perfect as if of hammered steel.



A GEAR UNDER WAY.

The process of manufacture of a pinion is shown in one of the illustrations, which represents the pinion forging, the pinion blank, milled, bored and seated, ready for the teeth to be cut, and the finished pinion ready to ship. A steel gear, bolted together and machined, with part of the teeth cut, is also illustrated. These teeth are cut from the solid stock by specially made cutters, themselves designed after exhaustive experiment. The pinions are cut from the best hammered steel forgings, and the teeth are cut with the same care as is taken in the cutting of the gears. All, that is both pinions and gears, undergo a rigid inspection before shipment.

The question of age of gears has not, perhaps, received from street railway managers the attention it deserves. In the life of gears there is a distinct difference between the extreme life and the proper economical life. There is a point in the age of gear and pinion at which it becomes more economical to consign them to the scrap heap and to use a new gear and pinion than to retain them in service. The question is a nice one, and a series of efficiency tests has recently been carried out. While the results are not yet collated, it may be said that a worn gear and pinion require some 400 watts more energy than a new gear and pinion. This is a statement made authoritatively, and one which will give food for profitable thought to managers of electric railways.

DRILL PRESSES, GEAR MACHINES, ETC., IN GEAR PLANT.

A Technical Education by Mail.

The strength and influence of a nation is measured by the average intelligence of its inhabitants, and that people which shows the greatest progressive spirit in the acquirement of knowledge is destined to lead all others. The facilities offered in America at the present time for obtaining an education have probably never been equalled in the past, and it is a well-established fact that the greater the facilities afforded the greater use is made of them. This is true in every branch of human activity, whether it is applied to the physical side of life or the mental.

To satisfy the growing desire for more extended knowledge, especially in the engineering branches, a method of instruction has been developed in late years which is doing excellent work—we refer to the correspondence schools. Thousands of young men all over the world, who have not enjoyed earlier opportunities of learning, are earnest students under this system, and thousands by the benefits thus derived have been placed in positions where they can command better remuneration for their services. The United Correspondence Schools, New York City, is one of these worthy institutions, and is doing good work in its line. Many men are receiving instruction in engineering in every branch, including mechanical, electrical, steam, civil, sanitary, etc.; art and architecture; and the various trades, including metal working, pattern making, etc. The instruction also includes a course in mathematics, mechanical drawing and mechanics.

The method of imparting instruction is through the instrumentality of accurately prepared and concisely written instruction papers, which are mailed to the student from time to time as he progresses in his studies. The students, as a rule, are persons who are engaged in business during the daytime; it is necessary, therefore, to devote the evening hours to study at home. The teacher is always accessible (by mail) to the student, and it is part of the general plan to encourage frequent communication between the two, in order that the student may be certain that he is working along the proper path. The instruction is, therefore, practically of a personal nature. The students' work is revised and corrected, if needed, and the lessons are graded and progressive. The school makes it a point to deal with each student, wherever he may be, with as much care and attention as if he were being instructed by word of mouth. It recognizes also the importance of giving satisfaction in each case.

The instruction in each branch is very comprehensive, and is devoid of matter that has no bearing on the particular work in hand. The instruction papers are accompanied by question papers, which questions the student is required to work out and answer, and send his answers to the school for review. All errors are pointed out, and the correct methods of working out the examples carefully

shown. If the work does not receive a mark of 90 per cent. the student must re-write the faulty part until the instructor is satisfied that he understands the subject. No half-way work is permissible, and this rule is rigidly adhered to, for the success of the system depends upon the thoroughness of the instruction and the insistence that the students' work shall conform to the high standard set by the school. The school does not require or expect its students to do impossible things, but it does believe that what is worth doing is worth doing well.

Obviously a great deal could be written in favor of this system of education, but the limits of our space will not permit of any more than a superficial account of how the work is carried on. The correspondence school system occupies a unique field, and was developed to meet a want that could not be satisfied by any of the older methods of education. It was designed primarily for the business man, although many others, already educated, are availing themselves of the exceptional advantages afforded by the system for the easy acquirement of knowledge concerning up-to-date practice and processes.

The students can take as much time as they need to properly master the work, but they are not allowed to become negligent. School methods are adopted in every particular, and if a student becomes delinquent he must give an excuse for it, just as is done in public and private schools.

The headquarters of the United Correspondence Schools are at 154-158 Fifth Avenue, New York. The list of instructors in the various branches includes the names of twenty-seven gentlemen, each one of whom is a specialist in his particular line. The principal of the school is Mr. F. W. Ewald, who has had a large experience in this particular line of work.

Electric Railway at the Brussels Exposition.

In a recent number of an English contemporary a brief description is given of the Tervuren Tramway at the Brussels Exposition. Some forty motor cars are employed on the line, and these ride with little noise and great ease. Each is equipped with two 25-hp Walker motors and controllers, which are said to give excellent results. The generating station is also equipped with Walker dynamos, the total capacity being about 150 kilowatts. Ornamental side poles with short arms carry the trolley wires, but as the trees along the boulevard grow these will be almost entirely concealed. The whole installation affords a fine example of the combination of tramway and light railway methods. The last line was only opened on the 10th of May last, and there are already evidences of the increase in estate values along the line. In fact, the district will probably become one of the finest residential quarters of Brussels, as the tramway furnishes such comfortable and rapid means of communication with the centre of the city. On one of the services which traverse the route buffet cars are attached to the motor cars, and light refreshments can be obtained en route. This is certainly an innovation in electric tramway service, and is probably the first instance of a dining car on an electrically driven train.

The Brussels Exposition was held from May 24 to October 31, this year. A peculiar feature of this exhibition was that it was divided into two sections, separated by a distance of 8 miles. The electric railway above referred to takes its name from the Parc du Tervuren, in which one section of the exhibition was located. A broad avenue connecting the two parts of the exposition was constructed at great expense, and along this thoroughfare the electric railway line was laid.

Direct-Connected Multipolar Generator.

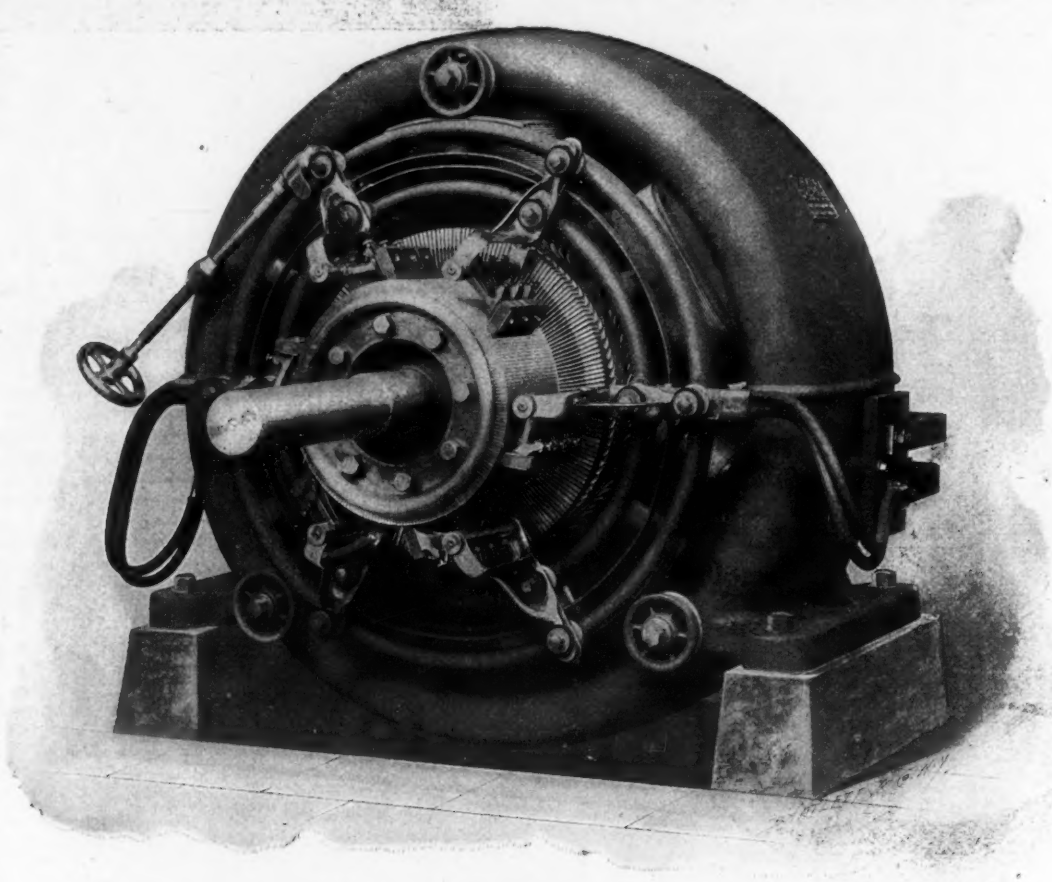
During the last five years the development of direct-connected electrical apparatus has so revolutionized the old methods and types of dynamos and motors that it is almost impossible at present to find any large electrical manufacturing concern that does not furnish machines for direct connection to engines or line shafting; and dynamos and motors of this type, especially in the larger units, are almost universally specified and required by purchasers of electrical machinery.

The accompanying illustration shows the latest form of direct-connected multipolar apparatus manufactured by the Bullock Electric Manufacturing Company, Cincinnati, Ohio, and embodies several radical and distinctive departures from all other types.

The field frames of the Bullock generators are cast in the form of an annular ring for the purpose of reducing the effect of stray magnetism and securing the greatest amount of strength and protection to the armature and pole pieces, as well as to conform to the smallest amount of space per pound of weight. Upon both sides of the frame are mounted the blocks for connection to the main supply feeders, making them very easy of access. There are six pole pieces in the 50-kw machine and eight in the 100 and 150-kw. The pole pieces are made of the finest soft laminated Norway iron and cast directly into the annular frame ring. The field coils are machine wound; the shunt and series coils being separately wound are mutually independent and removable. The entire arrangement is such as to give free and perfect ventilation to the poles.

The armatures are built up in the usual manner, and are of the ventilated iron clad type. The coils are carried in slots in the periphery of the armature cores and held in position by wedges in special recesses. This relieves the armature coils from any undue pressure and makes band wires unnecessary. Any coil can be removed without displacing any other coils than those immediately adjacent. The armature is thoroughly ventilated.

The commutators are of large dimensions, and run very cool and practically sparkless. They are built up of drop-forged copper bars and insulated from one another with selected East India mica. The brushes are of the carbon reaction type, and the brush holders are so designed as to afford an excellent contact between them and the brushes and between the brushes and the commutator. The machine is provided with self-oiling and self-aligning bearings.



Direct-Connected Multipolar Generator.

Recent tests of these generators were made by the United States Government at Finn's Point, N. J. The machines were in a closed vault, and carried their maximum load continuously for five hours, with an overload of 50 per cent. for one hour, and 75 per cent, for fifteen minutes, with a rise in temperature of less than 60° F. They operated noiselessly and sparklessly during the entire range of overload, no arrangement or shifting of the brushes being necessary. Similar tests were made on a 50-kw generator loaded to a capacity of 75 kilowatts, at 120 volts, for the engineers of the United States Navy. The entire load was thrown on and off several times, by rapidly opening and closing the switch, without any injurious effect whatever on the machine.

NEWS OF THE WEEK

Financial Intelligence.

A TERRE HAUTE (Ind.) dispatch states that the court has given Receiver Jump, of the Terre Haute Electric Railway Company, authority to borrow $25,000 to buy boilers and otherwise enlarge the capacity of the company's plant.

THE WEST END BOSTON ELEVATED LEASE.—The Massachusetts Board of Railroad Commissioners has declined to approve the lease of the West End Street Railway to the Boston Elevated Railroad Company on the terms proposed.

THE NEW ORLEANS TRACTION COMPANY reports gross earnings for October of $83,888, a decrease of $20,307, as compared with the same month of last year, and net $22,100, a decrease of $23,419. For the ten months ending October 31 the gross earnings were $1,040,282, a decrease of $68,392, as compared with the corresponding period of last year, and net $318,511, a decrease of $167,401.

THE ANNUAL REPORT of the West End Street Railway Company, Boston, for the year ended September 30, shows the following results: Gross earnings, $8,719,031, an increase of $377,073, as compared with the gross earnings of the previous year; operating expenses, $6,213,709, a decrease of $120,910; net earnings, $2,505,322, an increase of $497,983, leaving a balance, after deducting charges, of $1,624,947, an increase of $412,208. The dividends paid amounted to $1,193,375, an increase of $45,425. The surplus is $431,572, an increase of $366,783. In his annual report, President Little stated that the operation of the completed portion of the subway has been conducted with much satisfaction. The expense for renewals and repairs of track during the past year exceeded $800,000, and this amount cannot be reduced in years to come if the business of the company continues to increase and the tracks are to be kept in condition satisfactory for the operation of the road. The old board of directors was re-elected.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK Nov. 27 1897.

THE SPRAGUE ELECTRIC COMPANY will move its general offices from the Postal Telegraph Building to the new Commercial Cable Building, at 20 Broad Street, where it will accupy the fifteenth floor, and as soon as the alterations in partitions, etc., are effected the change will be made.

INTEREST IN THE NEXT ELECTRICAL EXHIBITION to be held in this city next May is taking a very substantial shape. The demand for space is even larger than was looked for, and it comes from the leading representative firms in the electrical, steam and kindred trades. They are planning to spend money liberally in making their exhibits attractive. Madison Square Garden will afford plenty of scope for this sort of work, and present indications point to a remarkably brilliant display.

THE NEW YORK ELECTRICAL SOCIETY held its first meeting of the season of 1897-98 in the new engineering building, Columbia University, New York, on the night of November 22. There was a good attendance, notwithstanding the comparative inaccessibility of the new location of the University to the members residing down town. Dr. M. I. Pupin, president of the society, gave an outline of the work laid out for the society during the present season, after which he delivered an adddress on "The Physics of the Ether." The burden of the address was in proof of the identity between the laws of light and the propagation of electromagnetic waves. Neither light nor electricity can be conceived, he said, unless the theory of an all-pervading ether is accepted. After the lecture the members visited the University power house.

OPPOSITION TELEPHONE SERVICE.—According to a Detroit dispatch, New York City is to be the scene of a telephone war. President William W. Holmes, of the Detroit Telephone Company, has been in New York. On his return to Detroit he gave out the information that New York is to have a 50,000 telephone exchange run by a new company that will cut deeply into the rates charged by the Bell Company. He further reports that the promotors of the proposed company are prepared to invest $15,000,000 in the enterprise, and operate 50,000 telephones in Greater New York, charging for its service $24 for house telephones and $48 for business instruments. His company, Mr. Holmes states, owns and manufactures a switchboard that does not infringe the older patents. The plan of the new company, he says, contemplates the establishment of toll stations in every city in New York State, with wide connections. The name of the new company is the Citizens Telephone Company, of New York and New Jersey. Mr. E. K. Sumerwell is president.

LAYING THE SANDY HOOK CABLE.—On Friday last the cable steamer "Mackay-Bennett" laid the middle section of the Postal Telegraph Cable Company's new submarine cable which is to connect Sandy Hook with the Commercial Cable Company's station on Coney Island. This cable, as was announced in the last issue of THE ELECTRICAL WORLD, is to be used for marine news service in announcing the arrival of steamers and other vessels at the port of New York. A party of invited guests were taken aboard the "Mackay-Bennett" at the White Star pier at 9 o'clock A. M. for the purpose of affording them an opportunity of witnessing the practical operation of laying a submarine cable. The weather was rather stormy, but seafaring men do not mind the weather when there is serious business in hand. The guests not being inured to the hardships of sea life showed a preference for the shelter of the cosy cabin of the steamer. The work of splicing the Coney Island shore end with the middle section was watched with the greatest of interest by the guests. The preceding stage of the work, however, gave them an inkling into the courage and endurance of the sailor. A crew manned a small boat, and rowed through the heavy sea to pick up the buoy to which the shore end of the cable was fastened. The work was performed without any mishap. The splice with the Sandy Hook shore end could not be made the same day on account of the early approach of darkness. The end of the new section was buoyed near the end of the Sandy Hook section, and the joining of the two ends was effected the next day, Saturday. The cable, by this operation, was made whole and continuous between Sandy Hook and Coney Island, and the new service of the Postal Company was inaugurated at once. The "Mackay-Bennett" landed the party on terra firma about 7 P. M., after an eventful day for the "land lubbers."

THE TELEGRAPH RATE WAR.—A story was published in some of the New York daily papers a few days ago to the effect that warlike hostilities had broken out between the Western Union Telegraph Company and the Postal Telegraph Cable Company, and that a war of rates would be the result. Inquiry among the principal officials of the two companies, however, developed the fact that there is no cause for such a state of affairs. The relations of the two companies are the same as they have hitherto been. A prominent Western Union official characterizes the story as "bosh." The report presumably was occasioned by the success of the Postal Telegraph Company in securing an office in the new Waldorf-Astoria Hotel. It is stated that the Western Union Company has always employed every means possible to prevent the admission of the Postal Company's wires in the hotels throughout the country. The plan did not work in the Western cities, but in New York, Western Union influence has heretofore prevailed in most of the principal hotels, but when the Waldorf-Astoria was opened, its proprietor decided to give both companies equal privileges in opening offices in the immense hotel establishment. The Western Union Company, it is stated, objected to the granting of this privilege to the Postal Company, and threatened to withhold its facilities from the hotel if it was done, laying great stress on the inability of the Postal Company to furnish marine reports. Nevertheless the Postal Company has established its office, and the Western Union has withdrawn. A prominent Western Union official states that his company did not continue its office in the hotel simply because the company and Manager Boldt could not agree as to terms. The terms imposed, we are informed, were that the Postal Company should be excluded. This incident was, now it appears, an important factor in the determination of the Postal Company to inaugurate a ship news service. We are informed that the Postal Company had been asked several times by representatives of shipping interests to establish such a service, but it had not been deemed advisable to undertake the enterprise until recently, when the hotel controversy brought the matter to a head.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Build'ng, 620 Atlantic Ave.,
BOSTON, Mass., Nov. 26, 1897.

MR. W. W. BURNHAM will hereafter carry on alone the business formerly done at 281 Tremont Street, Boston, by the partnership known as the Burnham-Gethins Company, and which was dissolved November 24.

THE GIBBS ELECTRIC MANUFACTURING COMPANY, Hartford, Conn., is kept busy in filling its orders. A pioneer in switch manufacture, as is Mr. Gibbs, is always sure to command liberal recognition from the electrical trade.

THE PRATT & WHITNEY COMPANY, Hartford, Conn., reports an excellent home demand for machinery and tools and continued foreign orders, and its executive offices and activity of officials abundantly substantiate such happy conditions.

THE BILLINGS & SPENCER COMPANY, Hartford, Conn., does not lose at all its popularity with the electrical trade. Its drop-forged specialties are always in good demand. Quality and excellence of manufacture are its strong claims for business.

THE BELKNAP MOTOR COMPANY, Portland, Me., distributed Thanksgiving turkeys to its employees having families, and nice remembrances to those unmarried. Not an employee was forgotten. The writer was present when the gifts were presented by Manager Brown. It was gratifying to witness the genuine pleasure in bestowing and receiving.

THE HART & HEGEMAN MANUFACTURING COMPANY, Hartford, Conn., reports excellent business, which it not at all surprising, as its switch manufactures have been "tried and found not wanting" for so many years. Mr. Hart keeps all manufactures "up to date," and is even anticipatory, and Mr. Pease knows exactly how to handle the executive helm.

THE PERKINS ELECTRIC SWITCH MANUFACTURING CO., Hartford, Conn., reports good and constantly increasing business. Mr. Charles G. Perkins is as active as ever in the conduct of this business, and is ably seconded by Secretary Hooker and Superintendent John Tregoning, while Messrs. Hill and Camp, the salesmen of the company, are constantly in touch with the trade.

THE HOPE ELECTRIC APPLIANCE COMPANY, Providence, R. I., is receiving liberal orders for its new and complete line of instantaneous "make and break" switches, cut-out boxes, mast arms, etc. The new rules and requirements of the National Board of Fire Underwriters insisting upon quick make and break action is bound to tell favorably for the products of the Hope Company, which comply with them most fully. A recent visit to the factory of this company was greatly enjoyed. In machinery, equipment and facilities, it is eminently qualified to produce its specialties efficiently and quickly.

THE MONARCH MANUFACTURING COMPANY, of Waterbury, Conn., is doing its best to keep up with the orders it has for the Monarch engine stop. This device is reported as giving excellent satisfaction wherever used, and there is therefore naturally a big demand for it. The object of the engine stop is to enable one in case of an accident to instantly stop the engine by the simple pressure of electric buttons in different parts of the engine room and building. The business is in good hands. Mr. A. M. Young is president of the Monarch Manufacturing Company, and Mr. George C. Blakeslee secretary.

THE AMERICAN ENDOSCOPIC COMPANY, of Providence, R. I., has become an important factor in the manufacture of high-grade decorative and miniature lamps. The company was originally established to supply medical instruments lighted by small electric lamps, and has made so great a success in this line that it has secured the services of Mr. H. J. Jaeger, the well-known inventor, and under his superintendence the company is now also manufacturing decorative and miniature lamps of all kinds. Mr. W. A. Fenner, the manager of the company, seems to possess the business energy and push to ensure the success of anything he undertakes.

MR. R. S. HALE, 31 Milk Street, Boston, in a circular just issued gives a suggested form of a "notice to customers," having for its object the application of the Wright-Demand system of charging to a business already established. The details of applying the system have to some extent prevented its adoption, but this circular of Mr. Hale will greatly facilitate matters in this direction. The method suggested provides for the ordinary commercial discount, if it is thought wise to give it, and it also provides for a minimum bill if desired. By changing the rates or number of hours per month during which the high price is charged the system can be fitted to any company so that the return from each customer will give a fair return for the cost of supplying that customer.

THE NEW ENGLAND ENGINEERING COMPANY, of Waterbury, Conn., continues to be busy. President A. M. Young is devoting considerable of his personal attention just at present to the construction of the plant of the Kings County Light Company, of Brooklyn, N. Y., and is therefore absent from Waterbury considerable of the time. Mr. A. D. Shepardson, however, looks after the Waterbury end of the business. The company occupies its own new building, and few construction companies in the country have as fine office quarters. There may be those in the business who do not remember that Mr. Young, who is also young in years, is a graduate of the telegraph business, and was also a pioneer in telephone construction. He is now one of the largest owners of stock in electric light companies in the country, and is, moreover, vice-president of the National Electric Light Association.

THE WEST END STREET RAILWAY lease to the Boston Elevated Railway Company, which received the approval of the Massachusetts Legislature and the Governor, has been refused ratification by the Railroad Commissioners of Massachusetts. This information, published last Tuesday, was considerable of a surprise, and the West End stock depreciated in the market about 14 points. The principal reasons of refusal assigned by the Railroad Commissioners are that the recompense to the West End Company, based upon the intrinsic value of its property, is not justified; that a lease of ninety-nine years is contrary to public policy, in conflict with the West End franchise of only twenty-five years, the subway lease of twenty years only, and that the immunities granted under the elevated charter exempted from the general street railway laws, or any special law that the Legislature might see fit to pass from time to time. In brief, the approval of the lease by the commissioners would form a contract which the Legislature would be powerless to alter, annul or impair. It could not be enacted, for example, that the underground conduit system should replace in the city of Boston the overhead trolley system, or that any other improved method of construction, equipment or operation, or any new safeguard, appliance or device should be adopted anywhere on the West End lines, unless the same burden or duty were at the same time imposed by general law on all of the street railway companies of the State.

Buffalo and Niagara Falls Notes.

Buffalo. N. Y., Nov. 26, 1897.

THE TONAWANDAS are complaining bitterly that the transmission of so much of the Niagara power to Buffalo is a violation of the contract made with these towns, by which the Niagara power authorities agreed to furnish them as much power as they wanted, and at a rate 10 per cent. less than it is furnished to Buffalo.

LAST MONDAY NIGHT an explosion of illuminating gas occurred in the neighborhood of the Niagara power subway in this city, causing a fierce fire for a short time, which resulted in shutting off all service pipes and wires in the vicinity. The Niagara current had just been turned on when the unfortunate affair occurred.

NIAGARA POWER IN BUFFALO.—The cable that is to carry the Niagara Falls electrical power to the other side of the Buffalo River was laid on November 18. Most of the new power will be utilized on that side of the river, and the cable forms part of the line extending from the unfinished transformer house near the water front.

THE BUFFALO TRACTION COMPANY is increasing its trackage in the city at a rapid rate, and by the end of the year will have in operation about 18 miles of the 66 included in the franchise. The line to Tonawanda is being developed also, and it is being arranged to retain the power house in that place, which is capable of developing about 125 electrical horse-power.

NIAGARA POWER IN CANADA.—The activity of the Canadians on the other side of Niagara Falls in regard to their share of the electric power of the Falls is such that a cry of alarm has been raised on this side. When the Falls power was being absorbed on this side the complaint came from the other; now things are reversed. It is planned that the Canadian power shall be obtained by dredging the Chippewa, a small river that enters the Niagara just above the Falls, so that it will run backward and discharge into a power canal at Montrose, thence to Thorold, thus obtaining a fall of 150 feet. It is stated that English capitalists are in the scheme. Americans, of course, see in it a diminution of the volume of water going over the Falls, especially since they will get nothing out of it.

ELECTROLYSIS OF WATER PIPES.—About two months ago the water department became uneasy over the continued giving out of its pipes, and put Messrs. Spire and Franchot, two experts, at work to investigate the cause. They found that the trouble resulted from stray currents from the street railway return circuits, and that the pipes in the immediate vicinity had become honeycombed by the electrolytic action. Electrolysis, it is stated, has spread to an alarming extent throughout the city. The experts found that some pipes showed a difference of potential of twenty-five volts, as compared with the surrounding earth. It was also discovered incidentally that these stray currents were being utilized by enterprising persons to their own advantage. A man was found charging a small storage battery from the current obtained from the water main. The discoveries of these experts have been such as to alarm both the gas companies and the street railway companies, and both have gone seriously to work to remedy the trouble.

THE CANADIAN NIAGARA POWER LEAGUE has issued a circular letter making it a matter of patriotism and home pride to join the same. The subscription is $1 a year for each member, and as much more as he pleases to subscribe. The circular declares that all of the best natural facilties for power development are on the Canadian side of Niagara Falls, and that by reason of greater American activity they have been allowed to remain undeveloped, while Canadian enterprises have crossed the river to obtain the benefit of the power already available. It is generally believed, however, that the move is largely a bluff, aimed in part, at least, at the Niagara Power Company, which has a Canadian franchise, but which has never been made use of. This company is watching the situation with much interest, and has already taken steps to begin operations sufficient to hold its franchise and at the some time prevent the building of a rival plant. Had there been no danger of competition on the Canadian side, it is believed that the Niagara Power Company would hardly have started any operations on that side, but now it may be obliged to do so.

Pittsburg Notes.

Pittsburg, Pa., Nov. 26, 1897.

MORE PROTESTS AGAINST THE UNITED TRACTION ORDINANCE.—At a meeting held by the Chamber of Commerce of Allegheny a few days ago a resolution was adopted condemning the ordinance passed by Councils last week, granting privileges to the United Traction Company. The mayor was requested to withhold his signature from the ordinance until a public meeting could be held, in order to give the citizens an opportunity for the expression of their opinion in regard to the ordinance. This the mayor has agreed to do, and a mass meeting has been called for the latter part of this week, at Carnegie Hall, to determine what the public sentiment is in regard to the matter.

IT IS REPORTED that Alexander Brown & Sons, representing a syndicate of Baltimore, London, New York, Philadelphia and Pittsburg capitalists, have purchased all the stock of the United Traction Company, of Pittsburg, amounting to $20,000,000, of which $3,000,000 is preferred and $17,000,000 common. This will give them control of the largest street railway system in Pittsburg and Allegheny, owning and operating over 117 miles of electric lines. The United Traction Company is a consolidation, effected about July 1, of all the lines formerly owned and operated by the Second Avenue Traction Company, running through some of the principal streets of Pittsburg and connecting that city with various suburbs. It controls the only access by street railway to Pittsburg on both sides of the river from the valley of the Monongahela. The consolidation also included all the lines formerly owned and operated by the Pittsburg, Allegheny and Manchester Traction Company and the Federal Street and Pleasant Valley Passenger Railway Company, comprising practically all the lines in the city of Allegheny.

PUBLIC LIGHTING IN ALLEGHENY.—The annual report of the Bureau of Public Lighting, of Allegheny, for the year ending February 28, 1897, has recently been printed. The number of arc lights added during the year was 126, making a total of 1037 in operation at the end of the year. The number of arc lamps per square mile of the city's area is 138, an increase during the year of 17½. Four hundred new incandescent lights were installed during the year, making a total of 3400 now in operation. The total present value of the arc system is given at $259,258.43, and of the incandescent system, at $89,622.96. The cost of operating for the arc system was reduced from $61.25 per light for the year 1895-96, to $53.56 for the year 1896-97, a decrease of 12½ per cent. These figures do not include interest on investment, or any allowance for depreciation. The reduction is stated to be due to improved station conditions and to freedom during the year from accidents to employees and apparatus. The total expenditures for operating during the year were $51,791.63 for arcs, and $13,633.47 for incandescents.

PROPOSED IMPROVEMENT IN THE POLICE SIGNAL SYSTEM.—An important impovement has been devised for the city's police signal system, and the superintendent of police has been instructed to procure estimates upon the cost of carrying it out. Under the present arrangement each officer is expected to report to the station in his district every hour from one of the patrol boxes on his beat. Necessary orders or information can be communicated by telephone to each officer in turn, when he calls up the station to make his report, but a full hour may elapse before the entire force on duty can be reached in this way. Since occasions sometimes arise making it extremely important to communicate promptly with all the officers on duty, the following plan has been devised to enable this to be done: It is proposed to equip each patrol box with an upright arm for daylight signals, and a red lamp for use at night. These arms and lights will be controlled from the station in each district, and when the officials at headquarters wish to give instructions or information quickly to the patrolmen a switch will be turned, which will display the signal on all the patrol boxes in the district. The arm will be dropped to a horizontal position, or the red lamp lighted, as the case may be. When these signals are displayed, it will be the duty of every officer to hasten to the nearest box, call up the station, and wait for orders. In this way it is expected that instructions can be conveyed to the entire force within a very few minutes, and the apprehension of criminals, etc., will be greatly facilitated.

MILWAUKEE NOTES.

MILWAUKEE, Wis., Nov. 25, 1897.

NEW RICHMOND, WIS.—The city is now lighted by electricity. The power is generated at Apple River, which is 8 miles from the city.

PORTAGE, WIS.—The telephone company which has its headquarters here has strung about 200 miles of wire, and Lodi has been reached. In the spring the line will be extended to Madison.

THE ELECTRICAL ENGINEERING COMPANY, of Milwaukee, Wis., has been incorporated. Mr. Jacob Cloos is president, and Henry R. King secretary and treasurer. The Cloos electrical specialties for high-tension work will be manufactured.

FOND DU LAC, WIS.—A new telephone company has been formed here, with O. F. Watter, president; Theodore Manderscheid, secretary, and A. C. Dallman, treasurer. A line will be built along the east shore of Lake Winnebago to Calumet, a distance of 12 miles. It will connect with the Horseshoe line, now in course of construction, connecting this city, Calumet Harbor, Winnebago Park, Calumet village, Malone and Marytown. Work will be commenced as soon as the weather and the formation of contracts will permit.

ST. LOUIS NOTES.

ST. LOUIS, Mo., Nov. 25, 1897.

ELECTRIC RAILWAY ENJOINED.—David Ranken, Jr., a property holder, having interests along the St. Clair County Turnpike, on November 24 secured an injunction against the St. Louis, Belleville & Suburban Electric Railway Company, restraining it from continuing the work along his property.

THE CITY LIGHTING CONTRACTS.—The Missouri-Edison Electric Light & Power Company, the Citizens Electric Light & Power Company, and the Imperial Electric Light Company, will all bid for the city lighting, and will be ready by the time the specifications are ready. Work has been pushed, and unusual activity has been shown by the last two companies.

ELECTRIC ROAD TO BELLEVILLE.—All arrangements were made early during the week for a complete transfer of the St. Clair Turnpike to the St. Louis & Suburban Electric Railway Company, and the management of the latter will now see that all work on the line is now pushed with vigor. The Day line also has a number of men and teams at work, and it appears that East St. Louis and Belleville will really be connected by two electric roads.

IT IS RUMORED that the attempt of the Lindell Railway Company to get a franchise to extend its tracks to O'Fallon Park is being made as a bluff at the Hamilton syndicate, in order to compel the latter to sell out or agree to a consolidation. The Lindell road already cuts into the business of its rival, and if it secures the new franchise it would become still more formidable. The Hamilton people were ready to sell to the Lindell three years ago, but the deal fell through.

KINLOCH TELEPHONE BONDS.—A special meeting of the stockholders of the Kinloch Telephone Company has been called for January 27, for the purpose of voting on a proposition to issue bonds to the amount of $1,500,000. It has practically been agreed already that the bonds be issued. Not a single bond will be allowed to go on the open market. It is thought they will be 5 per cent. bonds, to run twenty years, and that they will be secured by a mortgage covering the conduits, wires, switchboard, office furniture, and, in fact, the entire plant and property belonging to the company. Up to this time the company has paid out in the neighborhood of half a million dollars. In order to meet this and the additional expenses the company will float its first bonds.

TEXAS NOTES.

SAN ANTONIO, Texas, Nov. 19, 1897.

THE CITY COUNCIL OF BROWNSVILLE, TEXAS, has just granted a franchise for an electric-light plant to John Turner Smith, of Austin, Tex. Brownsville has a population of about 7500 and has never had electric lights. Mr. Smith will purchase the machinery and begin the work of installing the plant very soon.

A SYNDICATE of Ohio and New York capitalists have purchased the two street railway systems of Denison and the two of Sherman, and as already outlined, they propose to construct a line connecting the two cities. The new company is nown as the Sherman-Denison Electric Rapid Transit Company. It intends to build a large park and first-class hotel on the line of the proposed road, midway between the two cities. It is estimated that the improvements will cost $750,000. The work of constructing the new line will begin within thirty days. The syndicate is represented by J. McGeogh.

A PARTY OF PROMINENT OFFICIALS of the Western Union Telegraph Company has been making a tour of the principal cities of the Southwest. These gentlemen arrived here from Arizona and spent two days inspecting the company's office and affairs at this place. The party consisted of President Thomas T. Eckert, of New York; Vice-President and General Manager R. C. Clowry, and Division Superintendent T. P. Cook, of St. Louis. The advent of the Postal Telegraph Company into Texas is said to have caused a determination on the part of the Western Union to make important improvements in its service in this State.

A FRANCHISE for a new electric-light and power plant has just been granted to C. L. Wakefield and associates by the City Council of Dallas, Tex. The company proposes to expend $100,000 at once in machinery and the construction of the system. It agrees to forfeit its franchise if it allies itself with any other electric company. Two thousand dollars forfeit was deposited with the city as a guarantee that the terms of the franchise would be fulfilled. There promises to be plenty of competition in the electric lighting of Dallas, for, in addition to the old company and the one to which a franchise was just granted, the Consolidated Electric Street Railway Company, has also applied for a franchise for an electric light system on terms similar to the two already granted.

MEXICAN NOTES.

MONTEREY, Mexico, Nov. 20, 1897

IT IS REPORTED that the electric street railway in Guaymas, state of Sonora, has been sold to an American company, and that the new owners propose converting it into an electric line.

THE STREET RAILWAY connecting the towns of Torreon and Lerdo, in the state of Durango, has just been completed. The contractor was S. J. Breen, one of the most prominent American business men in Northern Mexico. Just at the close of his contract, Mr. Breen was arrested on some charge, the nature of which is not yet known to his friends here. After spending a short time in jail at Lerdo he was released on bond, pending trial. Mr. Breen has been in Mexico a number of years selling electrical machinery.

THE MEXICAN ELECTRIC COMPANY, LTD., of the city of Mexico, which is known by the name of "Compania Mexicana de Electricidad," is meeting with much success in securing subscriptions to electric lights, both incandescent and arc, for mercantile houses and private residences. This new company is also furnishing electric power for several factories. The furnishing of power is a comparatively new thing in the city of Mexico, and it is believed that a big business can be built up in that line, as there are a great many industries there to which electric power can be applied. Fuel is very high priced and electric power is found to be much cheaper.

THE POSTAL TELEGRAPH COMPANY is about to secure a monopoly of the commercial telegraph business in Mexico. This company has signed contracts with the Mexican Central, Mexican National, and Mexican International railway companies for the exclusive use of their respective wires for commercial telegraph business for a long term of years. The company has already entered Mexico by way of El Paso, Tex., and has opened an office in the city of Mexico. It is reported that it is doing the bulk of the through business between Mexico and the United States. The volume of business will be greatly increased as soon as connection with the Mexican National Railroad is made at the border, so that an office can be opened here and at other points along the line of that road.

PACIFIC COAST NOTES.

SAN FRANCISCO, Cal., Nov. 18, 1897.

MR. SIDNEY SPROUT, electrical engineer, recently left for New York, and will visit Eastern points of interest before returning to this coast.

THE INLAND TELEPHONE & TELEGRAPH COMPANY, which is a part of the Sunset Telephone Company's system, will build next season a heavy copper loop, connecting Walla Walla, Wash., with Baker City, Ore., the new line extending via Pendleton and La Grande, Ore., and to Boise, Idaho.

THE GENERAL ELECTRIC COMPANY has closed a contract to supply the electric generating plant for the Spreckels beet sugar factory, now in course of construction near Salinas, Cal. The equipment includes two 530-kw generators and two 300-kw generators. There will be about twenty motors of different sizes, all apparatus being of direct-current type.

THE CITY COUNCIL, of Port Townsend, Wash., recently passed ordinances repealing the franchises that had been granted, at various times, to six delinquent street railway companies. One of the franchises was owned by the Port Townsend Electric Street Railway Company, and the Belt Line Electric Street Railway Company was interested in another.

GEN. THOMAS T. ECKERT, president of the Western Union Telegraph Company, and Col. R. C. Clowry, superintendent of the company's lines West of New York and Pennsylvania, were recently in this city. These officials have been inspecting the company's Western lines in anticipation of very heavy business expected on account of mining in Alaska and California next year.

THE SUNSET TELEPHONE & TELEGRAPH COMPANY has commenced laying fibre pipe conduits in Los Angeles, Cal., where a city ordinance requires all electric wires within a large district to be buried by April 1 next. The company has already laid about 6 miles of street conduit, and will lay 1 mile additional in the conduit district and 1 mile in the West Office District.

THE SAN GABRIEL ELECTRIC COMPANY, of Los Angeles, Cal., has closed a contract with the Washburn & Moen Company for all of the wire for its new 23-mile transmission line to Los Angeles. There will be a double three-phase line of No. 5 hard-drawn copper wire on a single-pole line. With the wire used for distribution in Los Angeles the contract will amount to about $30,000.

THE ELDORADO LIGHT & POWER COMPANY, of Sacramento, Cal., has been incorporated, with F. F. Smith, W. C. Hendricks, R. C. McCreary, T. A. W. Schock and J. G. Cunningham as directors. Among its objects are manufacturing and producing electric light, power and heat from water power at the south fork of the American River. The capital stock is $300,000, of which $25,000 have been subscribed.

THE REALTY SYNDICATE has practically secured control of the Piedmont & Mountain View Electric Railway, which leaves the Oakland, San Leandro & Haywards and the S. P. R. R. lines the only street railway lines in Oakland, Cal., that are not controlled by the syndicate. The present income of the consolidated lines is about $35,000 per month. By shutting down the Alameda power station and the Oakland Consolidated power station, and operating all of the lines from the Piedmont power house, operating expenses can be considerably reduced.

TELEGRAPH LINE TO DAWSON.—Mr. C. R. Hosmer, general manager of both the Canadian Pacific Telegraph lines and the Postal Telegraph Company, and vice-president of the Commercial Cable Company, is in San Francisco conferring with John W. Mackay. He expressed his belief that a telegraph line would be built next spring from Ashcroft on the Canadian Pacific Railroad, via Quesnelle, to Dawson, a distance of 1400 miles. The projected line will be stretched along the same route that was surveyed and partly wired

in 1866-67, in an attempt to secure telegraphic communication around the world via Siberia, but which was abandoned when the success of the Atlantic cable was announced. The new line is expected to cost between $300,000 and $400,000. It will be built by the Dominion Government, and operated by the Canadian Pacific Telegraph Company. Branches to Juneau and other points may be built.

Canadian Notes.

OTTAWA, Nov. 25, 1897.

ELECTRIC ELEVATORS FOR THE TORONTO CITY HALL.—The Civic Board of Control for the city of Toronto has awarded the contract for the City Hall electric elevators to the lowest tenderer, the Sprague Electric Company, of New York. The contract price is $29,875.

PROBABLE SUBSTITUTION OF ELECTRIC POWER FOR STEAM.—There is a movement on fooot at Peterboro, Ont., for the purchase from the Grand Trunk Railway of the lines of railway extending from that town to Lakefield and Chemong, with a view to their conversion to electric roads.

THE CHATEAUGAY & NORTHERN RAILWAY COMPANY at Montreal is making preparations to handle an extensive freight business in connection with the Canadian Pacific Railway. It has ordered from the Canadian General Electric Company four motor G. E. 1000 equipments, including controllers. The outfit, though of less capacity, is similar to the large locomotive recently supplied by that company to the Hull Electric Railway, which has handled as many as thirty-three cars on a shunt.

THE BRITISH COLUMBIA ELECTRIC RAILWAY COMPANY has closed a contract to furnish power to the Esquimault Water Works Company. A power house, with Pelton water wheels and generators, will be erected at Goldstream, B. C., at which point the water works company will furnish the Electric Railway Company with a sufficient quantity of water, under an effective working head, to develop electrical power. The power will be transmitted to Victoria, and there stepped down and applied to the various purposes required by the company.

UTILIZATION OF WATER POWERS.—From all over Canada come reports of the utilization of water power for the purpose of generating electricity. The city of Belleville proposes drawing power for manufacturing from a falls near by, and Sterling will probably make use of the same source. In almost every large city in Canada steam-produced electricity has given place, or will shortly give place, to water-produced electricity. A big scheme is now proposed to divert the waters of Chippewa Creek over the Hamilton Mountain, and to supply electric energy therefrom for manufacturing enterprises, both in the cities of Hamilton and Toronto.

THE NIAGARA FALLS ELECTRIC POWER SCHEME.—There is still some speculation in Toronto about the company which proposes to bring electric power from Niagara Falls. It is confidently stated that the company will be organized within a fortnight, when the grand scheme will be formulated which aims at supplying between forty and fifty municipalities in Ontario with electric energy at one-quarter of a cent per hour per horse-power. The prospective company already has obtained an agreement from the city of Hamilton for the supply of cheap electric power. It is said that the proposed new company has millions of dollars at its back.

MONTREAL, Que., Nov. 25, 1897.

HAMILTON, ONT.—The Electrical Power & Manufacturing Company has asked the city to grant permission to supply electric power and light throughout the city.

TORONTO, ONT.—The ratepayers will be asked to vote on two questions: First, as to whether they favor the construction of a civil plant for lighting streets and public buildings; second, as to whether they favor an electric plant for commercial power and lighting purposes.

HAMILTON, ONT.—The Cataract Power Company, of which J. M. Gibson is president, has closed a contract with the Royal Electric Company, of Montreal, for the electrical apparatus required for the development of the water power at McCews Falls. The scheme will include the construction of a canal from Allanburg to the power house, a distance of 4½ miles, the contract for which has been let to Angus McDonald & Co. The canal will be from 40 to 50 feet wide.

MONTREAL, QUE.—The Royal Electric Company has received a contract from the city of Fort Williams for apparatus and machinery necessary for an electric-light plant at that place. The contract price is $13,000, and it is expected that the Royal Electric will complete it in two months' time. The city will do its own lighting. The Royal Electric Company has also made recently a contract with the town of Maisonneuve for street and residental lighting for a period of two years.

French Notes.

(From Our Own Correspondent.)

PARIS, France, November 14, 1987.

THE HEILMANN LOCOMOTIVE.—The tests of the completed new Heilmann locomotive have been commenced on the lines of the Compagnie de l'Ouest. The locomotive is intended to successively draw trains of 150, 200, 250 to 300 tons at speeds of 30, 50, 60 and 100 kilometers per hour. Only when the results of all these tests are definitely known can any final judgment be pronounced upon the advantages or inconveniences of the locomotive.

THE MEETINGS of the Société des Electriciens were resumed on November 10 under the presidency of M. Violle. Information was received from M. Mascart that several enlargements had been made in the School of Electricity, and he requested the society to authorize the issue of bonds for 60,000 francs. These will be put out as bonds of 100 francs each, paying 3 per cent. interest annually, and running twenty years. M. G. Loppé showed several interesting photographs of lightning striking the Eiffel Tower during the violent storm on May 31 last. The session closed with an interesting talk from M. Foveau de Courmelles concerning electro-therapeutic material and the possibilities of utilization by physicians in their various operations of the several varieties of currents furnished by commercial distribution plants.

English Notes.

(From Our Own Correspondent.)

LONDON, November 17, 1897.

INSTITUTION OF ELECTRICAL ENGINEERS.—Mr. J. Wilson Swan, F. R. S., has been elected president of the Institution of Electrical Engineers for the forthcoming session.

ACCUMULATOR TRACTION.—A paper on "Accumulator Traction on Rail and Ordinary Roads" was read by Mr. L. Epstein before the Institution of Electrical Engineers on Thursday evening last. Mr. Epstein takes a very rosy view of the prospects of accumulator traction. He considers, however, that the practice adopted on many lines in the past has been radically wrong. With regard to the handling of the batteries these should be dealt with as a whole and never disconnected cell from cell, except, of course, for repairing purposes. The batteries should be once for all installed on the cars, and charged and discharged in position. The nearest approach to an ideal cell for traction purposes, he considers, is one in which the positives are of the Planté type, with large surface and thin active material. Excessive overcharging is condemned, though occasional overcharging may be found advantageous inasmuch as a thorough mixing of the electrolyte is thereby brought about. In regard to cost the depreciation of the battery is set down at .35d. per car mile. Mr. Epstein recommends placing the batteries on a dummy car, the passenger cars being all trailers. Such a car sufficient to propel a fifty-two-passenger trailer for about eight hours would weigh about 3 tons. As each ton propelled, under normal conditions, increases the expenditure .4d., the extra weight of the dummy would increase the expense to about .3d. per car mile. The data in the paper are based upon Mr. Epstein's own tests together with running expenses of the Hanover and Birmingham battery lines.

ANOTHER TYPE PRINTING TELEGRAPH.—Last week I had an opportunity of examining an instrument called the "Zerograph," the invention of a Mr. Kamm. Although the instrument is not much larger than an ordinary typewriter, a departure from the usual step-by-step system has been made, two impulses only being sent to line for each letter. An arm, called by the inventor a synchronizing arm, is swung through a certain angle by a dropping weight, but in its normal position is held by an electromagnetically controlled catch at one end of its travel. There is a semi-circle of vertical pins, one pin corresponding to each letter or symbol on the keyboard, and it is above this semi-circle that the synchronizing arm swings. On depressing a key the first current is sent to line, the electromagnetic catch referred to is released, and the arm starts on its travel, it being stopped by the pin corresponding to the key depressed. This sends a second impulse to line and stops the synchronizing arm of the other instrument. At the moment of this second contact the local circuits of the printing magnets are closed, and a magnet is also energized, which brings back the arm to its initial position. The line current required is only 12 milliamperes, and the arm takes half a second to swing to the limit of its travel and back. The letters most frequently used, however, are placed on one side of the keyboard, so that the average time per letter is but a small fraction of a second. It is claimed that the instrument can transmit twenty-five words per minute. Mr. Kamm has also devised a type printing telegraph which prints a message in lines instead of on a tape. An extra contact is provided at the end of the swing of the synchronizing arm which completes the local circuits of extra electromagnets, these moving the paper forward and bringing it back to the commencement of the line. This latter type of instrument, however, is hardly beyond the experimental stage.

General News.

The Telegraph and Telephone.

SEATTLE, WASH.—The Klondike telephone line from Dyea to the lakes has been completed to Sheep Camp.

DANVILLE, KY.—The franchise for erecting and maintaining a telephone system for a period of twenty years will be sold December 10.

SHELL LAKE, WIS.—Contracts have been let for the construction of the Wisconsin Valley Telephone Company's line, from Shell Lake to New Richmond and Superior.

WARREN, OHIO.—A branch telephone line is to be built at once to connect Kingsman and Burg Hill with the main line of the Jefferson-Warren Telephone Company. A second exchange will be established in Warren next year.

ADRIAN, MICH.—The Adrian Telephone Company is building a line to Rome Centre, Springville and Onsted; also a line from Toledo by way of Fayette, Wauseon and Morenci. The latter will be ready for use in a few days.

TOLEDO, OHIO.—The local Harrison Telephone Company, it is reported, has passed into the hands of a receiver on account of default in the payment of interest on its bonds, which was due over a year ago. Mr. Daniel Morris was appointed receiver under a $15,000 bond.

CENTRALIA, ILL.—The Farmers' Telephone Company of Southern Illinois has been organized for the purpose of giving the towns of Jefferson, Marion and Wayne Counties telephone service. The principal office of the company is at Divide, and the company has secured a twenty-year franchise in this city. Work in line construction has already been begun.

CORSICANA, TEX.—A deal has been closed whereby the Southwestern Telegraph & Telephone Company absorbs the Mutual Telephone Company, of this

city. The exchange will be put in first-class condition, the improvements costing about $5,000. The Mutual Company was organized three years ago, and had 160 subscribers.

MONTPELIER, VT.—The Vermont Telephone & Telegraph Company has sold to the New England Telephone & Telegraph Company its entire system of 9000 miles of wire and 700 instruments, and extending over five counties. It is understood that the price paid was $50,000, the amount of the capitalization of the Vermont Company. The latter company had practically the entire business of the State, and the New England Company, it is reported, has for twelve years been trying to get possession of it.

ELECTRIC LIGHT AND POWER.

DUNKIRK, OHIO.—The question of municipal lighting is being agitated.

CECILTON, MD.—The city is agitating the question of lighting its streets by electricity.

MEDIA, PA.—The Borough Council has decided to advertise for bids for lighting the streets.

CHILTON, WIS.—The special election held resulted in favor of electric lights by a majority of five.

RICHMOND, ILL.—The village trustees are considering a proposition to install an electric light plant.

CUMBERLAND, MD.—All the proposals for the erection of the electric lighting plant have been rejected.

VAN WERT, OHIO.—The Van Wert Gas Light Company is figuring on the construction of an electric light plant.

HOLYOKE, MASS.—The Board of Public Works has decided to place a private electric lighting plant in the new high school.

WARWICK, N. Y.—The village officers have granted to Messrs. Sharpe & Chapman the right to erect an electric lighting plant here.

CUMBERLAND, WIS.—The city of Cumberland proposes to put in an electric light plant immediately, and is now negotiating for machinery.

NORTH ABINGTON, MASS.—The Abington & Rockland Electric Light & Power Company is about to expend $20,000 on its plant at this place.

KANSAS CITY, KAN.—The Consolidated Electric Light & Power Company will erect a two-story power house on the west bank of the Kaw River.

WHITESTONE, L. I.—Whitestone's new electric light plant, it is expected, will be in full operation by the first of the year. The work of installing the plant has already begun.

EAST CLEVELAND, OHIO.—An election will be held December 3 to vote on the question of issuing bonds for a municipal water and light plant. Mr. H. B. Chapman is Village Clerk.

FAIRVIEW, ILL.—The Council has granted to Peter Berger a fifteen-year franchise to operate an electric light plant in this place. For the first six years the franchise will be exclusive.

HUDSON, MICH.—Mr. Christian Burkhardt has purchased the half interest of Mr. James A. Andrews in the Hudson electric light plant and the Willow River water power. Mr. Burkhardt now owns the entire plant.

IRONTON, OHIO.—A special election will be held here on December 18 to vote on the question of issuing $20,000 bonds for the purpose of constructing an electric light plant for street lighting in connection with the water works.

DONALDSONVILLE, LA.—This city will receive sealed proposals for an electric light plant until December 20, 1897. Plans and specifications are on file with John F. Terreo, City Clerk, Donaldsville, and with George U. Borde, consulting engineer, New Orleans, La.

RUMFORD FALLS, ME.—An industry new to this country has reached an experimental stage at this place. It is to manufacture sodium. A small plant operated by electric power will be built on Bridge Street, to demonstrate that this chemical can be manufactured in this country.

DALLAS, TEX.—The City Council granted C. L. Wakefield and associates a franchise for a new electric light and power company. It is proposed to expend $100,000. C. H. Alexander and associates, the new owners of the Consolidated Electric Street Railway, have also applied for an electric light franchise.

COLUMBUS, OHIO.—The last shares of the stock of the Columbus Electric Light & Power Company have been formally transferred to a New York syndicate, and a new company will be organized, with a capital of $50,000. Mr. Emerson McMillin is at the head of the syndicate. The company's plant will be largely extended, and the cost of light and power reduced. The net earnings of the company last year, it is stated, were $42,000.

WASHINGTON, D. C.—Early in the morning of November 26 fire partially destroyed the station of the United States Electric Light Company, which is located at Thirteen-and-a-half and B Streets. More than half of the city was thrown into darkness as a result of the fire. Several dynamos were destroyed, which, together with the damage to the building, etc., entailed a loss between $50,000 and $60,000. It is stated that the company will not be able to renew its light and power services for several weeks yet. The engines and boilers were uninjured.

PAWTUCKET, R. I.—The Pawtucket Electric Company is offering every inducement to power users to adopt electric power. In a circular just issued by the company, it is stated that there are already in operation in that city about fifty motors, ranging in capacity from one-sixteenth to 20 horse-power and upward. The current used by motors is measured through meters, and charged at regular rates, subject to discounts, according to quantity consumed. It is stated that the present cost of power to these consumers is very much less than it formerly was, in some cases not one-half of what it was when running engines.

THE ELECTRIC RAILWAY.

TAMAQUA, PA.—An electric railway from this place to Pottsville is projected.

PITTSFIELD, N. Y.—An electric railway is to be built between this place and Albany, N. Y.

JOHNSTOWN, PA.—The extension of the Beech Creek Railway to this city is now practically assured.

WATERBURY, CONN.—The question of a trolley line from this place to Oakville is being talked about again.

CANTON, OHIO.—Pittsburg capitalists are seeking a franchise to construct a trolley line from Canton to Alliance.

PORT JERVIS, N. Y.—The Port Jervis Electric Street Railway Company will erect a power house on Ball Street.

PALO ALTO, PA.—A franchise has been granted to the Schuylkill Electric Railway Company to operate its lines in this city.

BRAMBLETON, VA.—The Ocean View Electric Railway Company has been granted permission to extend its line in Brambleton, Va.

CLINTON, MASS.—The Selectmen have granted the Clinton & Worcester Street Railway Company a franchise to operate in this city.

PELHAM, N. Y.—The Pelham Railway Company has petitioned the Board of Trustees of North Pelham for a franchise to operate in the city.

RANDOLPH, MASS.—The Boston, Milton & Brockton Street Railway Company has asked the Selectmen for a franchise for location of its tracks.

MANLIUS, N. Y.—The Syracuse & Suburban Railroad Company has petitioned the Highway Commissioners for a franchise to operate in this city.

WEST CHESTER, PA.—The line of the Philadelphia & West Chester Trolley Company will soon be extended from Newtown Square to this borough.

TRENTON, N. J.—The Pennington Avenue Passenger Railway Company has petitioned the city for a franchise to operate an electric railway in the city.

ERIE, PA.—The Meadville & Edinboro Street Railway Company is desirous of extending its line to this city. Mr. John W. Shyrock is president of the company.

DUNELLEN, N. J.—The Borough Council has been petitioned by the Brunswick Traction Company for a franchise to operate a trolley system through the borough.

CAMDEN, N. J.—The Camden & Suburban Railway Company will extend its line to Beiderman's. The company will also build an electric line along the Burlington Turnpike.

NEW ROCHELLE, N. Y.—The Larchmont Street Railway Company is arranging extensive improvements, and will probably change its surface road into an electric line next spring.

COLLEGE POINT, L. I., N. Y.—The New York & Queens County Railway Company has made formal application to the village trustees for a franchise to extend its route in this village.

GREENFIELD, N. Y.—The Highway Commissioners have granted the Ballston Terminal Railroad permission to construct and operate an electric railroad through Middle Grove to Leggett's Mills.

NEW ORLEANS, LA.—The City Council has accepted the bid of the Orleans-Jefferson Railroad Company for a twenty-five-year franchise for a street railway to run from this city to Lake City.

BALLSTON, N. Y.—It is proposed to construct an electric railroad between this city and Saratoga. Mr. Robert E. Dunston, of New York, general manager of the Saratoga Traction Company, is interested.

LINOLEUMVILLE, S. I., N. Y.—The residents of this place have presented a petition to the Staten Island Electric Railway Company, requesting that the company extend its line from Bull's Head to the village.

FITCHBURG, MASS.—The Fitchburg & Suburban Street Railway Company has petitioned the Common Council for a franchise to operate its lines in this city. The line will be built between Fitchburg and Leominster.

PATCHOGUE, L. I., N. Y.—The directors of the Patchogue & Port Jefferson Traction Company have decided not to accept the franchise offered to them by the local trustees and the Woodhaven Highway Commissioners.

WASHINGTON, D. C.—It is rumored that the Capital Traction Company of this city is negotiating for the purchase of the Washington Belt Railway, and that the latter road will be equipped with electric motive power.

ALBANY, N. Y.—The Railroad Commissioners have granted the application of the Dry Dock, East Broadway & Battery Railroad Company, of New York City, for permission to change its motive power to the underground-trolley system.

ROYERSFORD, PA.—A project is under way here for the organization of the Royersford & Trapp Electric Railway Company, which proposes to connect with the Schuylkill Valley Traction Company at Collegeville. The proposed capital stock is $75,000.

BANGOR, ME.—It is reported from Portsmouth that Messrs. Gerald and Libby, of the Portsmouth, Kennebunk & York Street Railway, have had plans made for the construction of eighty miles of new road in Maine, which will run in connection with their Lewiston line.

YOUNGSTOWN, OHIO.—A meeting of capitalists and local street-railway men was held here a few days ago to consider the proposition of effecting a connection between the electric railways in the Mahoning and Beaver Valleys, thus giving a continuous line from Warren to Pittsburg. A road is to be built at once from Ellwood Junction to Beaver Falls.

ALBANY, N. Y.—The State Railroad Commission has refused to grant permission to the Greenbush & Nassau Electric Railway Company to increase its capital stock from $180,000 to $325,000. The commission held that no considerable portion of the proceeds of the sale of securities which the company has the power to issue has been expended, and, further, that the estimates of cost presented by the company are excessive.

ALBANY, N. Y.—The Board of Railroad Commissioners has granted to the Metropolitan Street Railway Company of New York City approval of change of motive power from horses to the underground trolley system on Eighty-sixth Street, One Hundred and Sixth Street and One Hundred and Twenty-fifth Street, New York City. The application of the Syracuse & Suburban Railroad Company for the use of the overhead trolley system was also granted.

WASHINGTON, D. C.—The Baltimore Security & Trading Company on November 24 purchased the Eckington & Soldiers' Home Railway and the Belt Railway, both of which were formerly controlled by the Columbia & Maryland Railroad. The control of the latter company passes by this sale into the hands of a syndicate in which several New York gentlemen are interested, including Mr. J. E. Searles and Charles A. Lieb. It is stated that the underground trolley system will be installed on the Eckington line.

ALBANY, N. Y.—A lease for 999 years of the Coney Island & Gravesend Railway Company to the Nassau Electric Railroad Company, of Brooklyn, has been filed with the Secretary of State. Part of the Gravesend Company's lines are yet to be constructed, but the lease covers the entire system. The consideration named is that the Nassau Company shall pay the costs of construction and all taxes and assessments on the Gravesend lines, and also the sum of $150,000 in cash, with 5 per cent. interest, within the next five years, or at the expiration of that period.

PERSONAL NOTES.

MR. NORMAN MARSHALL, vice-president of the Anchor Electric Company, Boston, Mass., was in New York during the week.

MR. JUSTUS ECK, managing director and consulting engineer of Messrs. Laing, Wharton & Down, London, England, is in New York City.

MR. MORRIS W. MEAD, superintendent of the electrical department of the Department of Public Safety, Pittsburg, Pa., is a visitor in New York.

MR. CYRUS ROBINSON has resigned his position as general manager of the Ridgway Dynamo & Engine Company, Ridgway, Pa., and will no longer be connected with that company. Most of the work heretofore done by Mr. Robinson will be looked after by Mr. A. L. Bell, secretary of the company.

MR. S. D. COLLETT, who has for the past three years been engineer of the interior block system of distribution of the New York Telephone Company, has resigned his position to accept that of Eastern manager of the Elevator Supply & Repair Company, of Chicago. Mr. Collett's office will be at 40 Cortlandt Street, New York.

DR. E. F. NORTHRUP, late professor of physics and electrical engineering in the University of Texas, has resigned that position to accept one with Messrs. Willyoung & Co., Philadelphia, Pa. Dr. Northrup is a graduate of Johns Hopkins University. His new position will be on the experimental staff of the concern with which he has become associated. His many friends wish him success in his new field.

EUGENE F. PHILLIPS is a name that has long been a household word among all classes of electrical workers. Mr. Phillips is president of the American Electrical Works, of Phillipsdale, R. I., and it is a coincidence that he began business in 1874, just about the time of the establishment of THE ELECTRICAL WORLD. Few manufacturers in any line are so well known to or so popular with their customers and the trade in general as is Mr. Phillips. The modesty of the man, however, gives no hint of the magnitude of the works of which he is president. On a visit last week to Phillipsdale, the writer was both surprised and pleased at the growth of the American Electrical Works in recent years. The factory buildings—fully a dozen in number—cover about three acres, and are beautifully located on the banks of the Seekonk River, about 3 miles from the centre of Providence. The various departments of the factory are equipped with the most improved machinery, for here is manufactured every kind of electrical wire or cable, from that for street railway feeders to the most delicate silk testing wire. This latter is so fine that it runs over 14 miles to the pound. The American Electrical Works receives the crude copper in one part of the works, makes this into wire in another, and covers this wire with silk, cotton or rubber in a third. Thus one can see at this establishment all the different processes of manufacture. Between 75,000 and 100,000 pounds of copper are used up every day. Altogether the magnificent plant is a monument of which Mr. Phillips, Superintendent Sawyer, Secretary Hathaway and others who have been identified with the work for so many years may well feel proud. In addition to this plant the company also operates another good-sized one in Canada, located at Montreal, of which Mr. John Carroll is secretary and manager.

OBITUARY NOTE.

ROSWELL HART ROCHESTER, for many years treasurer of the Western Union Telegraph Company, died suddenly on the night of November 25 at his home in Englewood, N. J., from heart disease. Mr. Rochester was born on August 17, 1839, in the town of Gates, Monroe County, N. Y., and was consequently fifty-eight years of age. He entered the service of the Western Union Telegraph Company as a clerk in 1865. He was appointed assistant treasurer of the company on July 1, 1866, and on the resignation of Judge O. H. Palmer as treasurer, in October, 1871, Mr. Rochester was appointed to fill the position thus rendered vacant. Mr. Rochester was a man of positive character. His integrity was of the most stalwart kind, and his judgment keen, prompt and decisive. The city of Rochester, N. Y., got its name from the Rochester family. His large circle of friends and acquaintances will be pained to learn of his sudden death.

Trade and Industrial Notes.

THE BALL ENGINE COMPANY, Erie, Pa., has just issued a neat little pamphlet describing its new governor, which was illustrated and described in THE ELECTRICAL WORLD of August 21.

THE SIEMENS & HALSKE ELECTRIC COMPANY is giving notice to the trade that all communications to that company must be addressed to its general office in the Monadnock Block, Chicago, and not to the factory at Grant Works Post Office, as has been the custom heretofore.

AMERICAN TELEPHONES FOR JAPAN.—The Northwestern Telephone Manufacturing Company, Milwaukee, Wis., last week shipped a liberal order of telephones to Yokohama, Japan. This company's apparatus, we are informed, is meeting with success abroad as well as at home.

THE DAVIS & EGAN MACHINE TOOL COMPANY, of Cincinnati, reports continued improvement in its European business. The strike in England is subsiding, and the demand for American tools is again good. The company also reports that its home trade is likewise on the increase.

MR. J. P. WILLIAMS, 39 Cortlandt Street, New York, general agent for the sale of the "Paragon" power and fan motors, has just returned from a successful business trip. He traveled through the Western States, where he reports finding business booming. He also found a lively demand for Paragon machines.

THE SARGENT COMPANY, Chicago, Ill., is distributing its December catalogue. The design of the calendar gives a good idea of the nature and scope of the company's business. The company is doing a good Western trade in electrical castings. The quality of its gears, pinions, brake shoes, etc., is of the highest standard.

THE ADVANTAGES of the Carhart friction clutch pulleys and cut-off couplings are set forth in a circular and price list just issued by Messrs. Timmis & Clissold, Bound Brook, N. J., who manufacture these devices. The Carhart clutch is simple and effective in operation, and is, besides, compact. A copy of the circular may be obtained on application.

MR. F. M. HAWKINS, 39 Cortlandt Street, New York, sales agent for the Crouse-Hinds Electric Company and Pass & Seymour, both of Syracuse, N. Y., is now carrying a large stock of the specialties manufactured by these concerns. Those in need of porcelain specialties for switches and switchboards will be able to select from Mr. Hawkins' complete stock of these goods.

THE COLUMBIA CALENDAR FOR 1898 is being distributed by the Pope Manufacturing Company, Hartford, Conn. This calendar has made its appearance regularly for thirteen consecutive years, and is very handy for the desk. It is in pad form, with a leaf for each day of the year. Each leaf has a large memoranda space, which is valuable for keeping notes of appointments.

MESSRS. MACHADO & ROLLER, 203 Broadway, New York, general agents for the sale of the A. E. G. incandescent lamp, state that, though this lamp has been upon the American market but about ten months its popularity among central station managers and other users is evidenced by the many large duplicate orders which are being constantly received for it. This firm will shortly place upon the market a new high-voltage lamp.

DURING THE LAST WEEK the C & C Electric Company reports having disposed of a large number of its closed, slow-speed, iron-clad motors for all classes of work. Inquiries and orders from abroad are becoming frequent. The good features of these machines seem to appeal to all users of motors. The motors are particularly adaptable for connection to all classes of machinery. The company reports a steadily growing demand for them.

OPERATION OF ELECTRIC MINING PLANTS.—The General Electric Company has just issued an attractively gotten up pamphlet, giving figures showing the cost of electric mine haulage, as compared with other power systems. It also gives comparative tests of electric and compressed air pumping, which exemplifies the superiority of the electric system. The pamphlet contains some fine illustrations of the company's mining apparatus.

THE CINCINNATI CORRUGATING COMPANY, Piqua, Ohio, reports that there is a very satisfactory demand for its iron roofing, siding, ceiling, etc. A leading feature of the company's output at the present time is galvanized iron roofing in various styles, which is claimed to be the best roofing material made, as well as the cheapest, when durability and quality are considered. Any one interested in metal roofing can obtain a copy of the company's catalogue on application.

BERGMANN INCLOSED ARC LAMPS will be installed in the new addition to Bloomingdale Brothers' dry goods store, New York City, a contract for the same having been closed by the General Incandescent Arc Light Company. Mr. F. E. Dolbier, manager of the arc lamp sales department of this company, states that the lamp is meeting with continued and increasing success, and is becoming popular. The service obtained by the use of these lamps, he says, is very satisfactory.

"THE ELECTRICAL FIRE WASTE" is the title of a pamphlet published by H. B. Squire, Chicago. Its contents consist of a résumé of lectures delivered by Mr. William H. Merrill, Jr., before the students in electrical engineering at the Armour Institute of Technology, Chicago, with such alterations in the text as to present the subject in language intelligible to the layman. The pamphlet is published in the form of the reports of the National Board of Fire Underwriters. Its subject makes very valuable and interesting reading, and several half-tone illustrations show some characteristic burnouts.

THE M. C. BULLOCK MANUFACTURING COMPANY, Chicago, is having a good trade with the Willans central valve engines. Since placing this engine on the American market four years ago it has installed engines for a variety of service, the larger portion having been placed in electric stations operating direct coupled. Among other orders the company is completing three triple-expansion condensing engines, of the automatic type, 240 horse-power each, to be direct coupled to Westinghouse generators, for the Nichols Chemical Company, of New York. This was a "repeat" order. Nearly 80 per cent. of the engine orders received by the Bullock Company during the past year have been "repeat" orders.

ALL ABOUT STEAM PUMPS.—A very complete and fully illustrated catalogue of steam and power pumps and pumping machinery, as manufactured by the Deane Steam Pump Company, Holyoke, Mass., has just been issued by that concern. It contains 132 pages, in which are described and illustrated the many designs of pumps, etc., made by the Deane Company. The list is a long one,

and covers a very wide range of application. The description of each class of machine is accompanied by a table of specifications and a telegraphic code. Some useful engineering information in tabular form is given at the back of the book, and a well arranged index of its contents facilitates the search for any particular subject within the scope of the catalogue.

THE INTERNATIONAL REGISTER COMPANY, Chicago, has recently closed a contract through their Philadelphia agents, Messrs. Mayer & Englund, with the Capital Traction Company, Washington, D. C., for the entire equipment of the latter's cars with International car registers of the single type. Two registers will be used in each car, one for cash fares and the other for tickets. This contract, together with the other rapidly increasing business of the International Register Company has made necessary a further enlargement of its factory. When the company removed to its present quarters last spring it was thought that sufficient space had been provided for the expansion of the business for some time, but a new lease has just been made for additional space, and the equipment and force will be increased at once.

MESSRS. WM. H. WESTON & CO., electro-machinists and engineers, 1303-1309 Buttonwood Street, Philadelphia, Pa., recently issued an illustrated catalogue of their very complete line of manufactures. This includes single, double and four-throw switches, quick-break railway switches, main and branch line fuse blocks, tablet cut-out boards, stage regulators or dimmer switches, regulator coils, equalizer switches and coils, rheostats, switchboards, etc. The illustrations are numerous and well executed, and show the details of manufacture with great clearness. Some tables and other electrical information for ready reference are given at the back of the catalogue, which is so bound as to admit of the easy insertion of additional sheets, which it is the intention of the firm to issue from time to time. The firm's factory is kept very busy just now in an endeavor to promptly fill the many orders for apparatus in its line.

THE SPECIAL DOUBLE-POLE CIRCUIT BREAKERS installed on the switchboard in the Boston City Hospital were tested in a rather unexpected manner recently. In a letter to the Cutter Electrical & Manufacturing Company, Philadelphia, Pa., Mr. Hatch, engineer of the electrical construction division, Public Buildings Department, Boston, gives an account of a peculiar accident which proved the merits of the circuit breaker. One of the men accidently dropped his wrench across the bus bars of a large tablet board, completely short circuiting one side of the three-wire system, which is balanced by a 5-kw motor generator. The circuit breaker (300 amperes) opened instantly, even before a 50-ampere fuse on the 5-kw unit could act. Had there been no circuit breaker the motor-generator would no doubt have been lost, and consequently the whole system would have been impaired. No damage, however, resulted, and no interruption of service was suffered except on this one feeder. Mr. Hatch, through this experience, is now naturally a strong believer in the Cutter circuit breaker.

Business Notices.

THE KLONDIKE COUNTRY AND COLORADO are now the two principal gold mining fields in the world. We can give you information about both, but as the Klondike country will be impenetrable until next summer, why not go to Colorado this fall and look over the golden opportunities of that State?

It is cheaper and easier to go to Colorado, and we will venture dollars to doughnuts that more net money can be made in Colorado in twelve months, with less capital, than in the outskirts of the Arctic Circle during the same period, at forty times the expense.

Ask the nearest agent for the price of tickets to Denver, Leadville or Cripple Creek, and tell him to send you via Chicago and Omaha over the Chicago, Milwaukee and St. Paul R'y, in the through sleeping car from Chicago to Denver.

For further information, address E. F. Richardson, General Agent Passenger Department, 381 Broadway, New York City.

A CARD TO THE PUBLIC.—As a protection to my business and the large interests of others connected therewith, I have been strongly urged by my customers throughout the country to give the public a plain statement of facts, which I trust will serve to refute the malicious statements which have been made in reference to my business, and scattered broadcast by those who, through self-interest, have sought to destroy a competitor.

In June, 1896, previous to starting upon a tour around the world, it was found that for the best interests of my business the services of J. D. Miller would no longer be required, and I then became sole owner of the stock of the Pierce & Miller Engineering Company, through the purchase of his small interest. E. A. Merrill, at that time in my employ, was placed by me as acting president in my place, to represent and protect the company's interests in my absence.

During six years of most friendly and satisfactory business relations, the Pierce & Miller Engineering Company paid a certain firm, known as McIntosh, Seymour & Co., about $1,100,000 for some 90,000 horse-power of its engines, which we largely introduced in the market under great difficulties. On my return from abroad, this firm demanded that I should sever my connection with an organization which resembles Free Masonry, in that its purpose is unsectarian humanitarian work.

Holding the position that independent thought and action is one's sacred right, so long as it does not interfere with the rights of others, I immediately severed my company's connection with this firm, and have since proved, to my own satisfaction, that I pursued the right course. To make further misrepresentations impossible, I am now taking steps to change the name of my company from the Pierce & Miller Engineering Company to "F. M. Pierce Engineering Company." Mr. Merrill is no longer in the employ of this company.

Still holding to the fact that "the best is the cheapest," we have made new arrangements on this basis, and now offer to our friends and the public the "Rice-Sargent" engine in sizes from 300 horse-power to 3000 horse-power; also the "Standard" Ball engine, built in Pennsylvania, in sizes from 20 horse-power to 500 horse-power—either machine of any type desired.

Using these engines, we are now prepared to contract for power plants exceeding in efficiency and economy the numerous high-grade plants we have installed in the past.

Strong financial connections we have made in London and New York now enable us to "finance" electric railways and other first-class enterprises; this, in addition to the enlargement of our old-established business of contracting engineers, through European connections. I take this opportunity to thank our friends for their liberal patronage.

F. M. PIERCE, President,
Pierce & Miller Engineering Company.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOVEMBER 23, 1897.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

593,981. APPARATUS FOR ELECTRICALLY HEATING METALS AND ORES; G. D. Burton, Boston, Mass. App. filed Feb. 20, 1897. In metal-heating apparatus, the combination of a tank for an electrolytic liquid, a receptacle in said tank, a detachable hearth surmounting said receptacle and above the level of the solution in the tank, and means for elevating said liquid from said receptacle so that it will overflow onto said hearth.

593,984. TROLLEY; R. W. Clarke, Victoria, Canada. App. filed Feb. 17, 1897. In combination a trolley pole having its upper end turned outward, two arms swiveled thereon, means for revolving said arms, means for securing said arms in their adjustment when revolved, a trolley wheel journaled upon each of said arms, and a switch so arranged relative to one of said wheels as to permit the passage of a trolley wheel carried by another car without interference with either.

593,986. SEPARABLE RECORDING METER; J. B. Cravath, Chicago, Ill. App. filed Aug. 12, 1897. The combination with the actuating parts of an electric recording meter, of recording mechanism separable therefrom, and separable gearing connecting the actuating parts of the meter and the recording mechanism to permit the removal of the recording mechanism for reading.

593,988. RESISTANCE DEVICE; G. K. Cummings, Chicago, Ill. App. filed Dec. 23, 1895. In an electrical resistance device the combination with cross pieces, of terminal rods supported on said cross pieces, two of said cross pieces being movable, a number of tubes containing electric resistance material of constant density, supported between the movable cross pieces, and means for adjusting the tubes on some of the terminal rods.

594,020. APPARATUS FOR FEEDING CABLES INTO UNDERGROUND CONDUITS; W. H. Johnston, St. Louis, Mo. App. filed July 28, 1897. In an apparatus for feeding cables into underground conduits, the combination with a curved tubular guide through which the cable may be passed and adapted for insertion within the manhole, of means for bringing an end of said guide into communication with a duct communication with the manhole, through which duct the cable is to be threaded, and means for securing the curved tubular guide in position at the manhole opening, said means permitting the sidewise movement of the guide by the cable as it is unwound, whereby the guide is maintained in alinement with the unwinding cable.

594,034. AUTOMATIC CIRCUIT CONTROLLER; C. W. Price, Newark, N. J. App. filed March 23, 1897. An electro-mechanical controller for an electric circuit, comprising a spring driven motor, holding devices for said motor, an electromagnet in a normally closed local circuit for operating one of said holding devices, another electromagnet in a normally open local circuit for operating the other of said holding devices, a main circuit and two circuit-controlling discs for said main circuit and operated by the motor.

594,036. RONTGEN RAY TUBE; H. L. Sayen, Philadelphia, Pa. App. filed April 29, 1897. As a means for varying the pressure in a high-vacuum tube, a main circuit for operating the tube and a shunt circuit for varying the pressure.

594,051. ELECTRIC BATTERY; D. S. Williams, Philadelphia, Pa. App. filed Aug. 23, 1895. A conductor and support for the active material of a battery electrode, formed of a single sheet of metal stamped or cut out and then bent transversely upon itself in such manner as to form a series of superposed channeled plates, united by integral yielding conducting strips.

594,060. TELEPHONE; T. Berdell, New York, N. Y. App. filed Dec. 27, 1895. In a telephone, two adjacent flexible diaphragms secured in place at their peripheries, and unencumbered at the centre portions of their facing sides, thereby leaving a free space between them at that place, and granular or spherical material confined between the diaphragms about the central space.

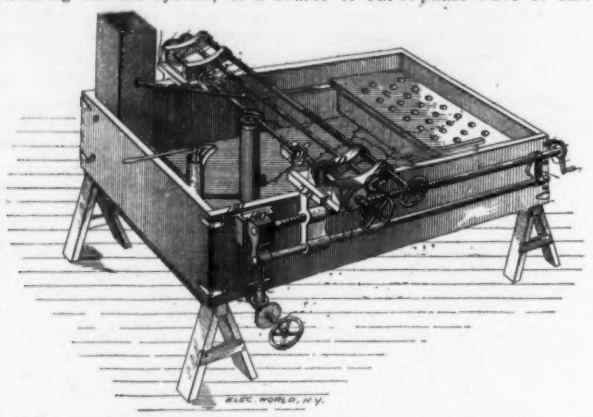
594,122. INDICATOR FOR UNDERGROUND ELECTRIC RAILWAYS; H. C. Reagan, Jr. App. filed June 4, 1896. In an electric railway, an insulated continuous sectional conductor, energizing means for its sections, brushes or other contact devices carried upon each end of a car, and adapted to contact with different sections of said conductor, an indicator connected with each of said brushes, a resistance coil connected with said indicators, and a wire from said resistance coil grounded in said frame.

594,131. BELL EXTENSION FOR TELEPHONES; E. S. Dickerson, Philadelphia, Pa. App. filed Aug. 11, 1897. The combination with the call bell lever of a telephone, of a flexible arm resting at one end against said lever,

a contact to which said arm is pivotally secured, a stop wherein the other end of the arm rests, a second contact arranged between the stop and the first contact, all arranged so that when the call bell lever oscillates the flexible arm will periodically engage the second contact, a local battery circuit wherein the contacts are included, and one or more signaling devices included in said local battery circuit.

594,143. REGULATING RONTGEN RAY TUBES; M. P. Rice, Schenectady, N. Y. App. filed July 17, 1897. An automatic vacuum adjuster for Röntgen ray tubes, consisting of a shunt circuit, including in the path of the current a volatile salt within the vacuum inclosure, and a high resistance in lieu of the usual spark gap.

594,144. REGULATION OF ALTERNATING CURRENT SYSTEMS; C. P. Steinmetz, Lynn, Mass. App. filed Dec. 22, 1893. The combination in an alternating current system, of a source of out-of-phase wave of current E.



No. 593,981.—Apparatus for Electrically Heating Metals and Ores.

M. F. between the feeding mains and a working sub-circuit of branch of the system, and a phase modifier in such sub-circuit.

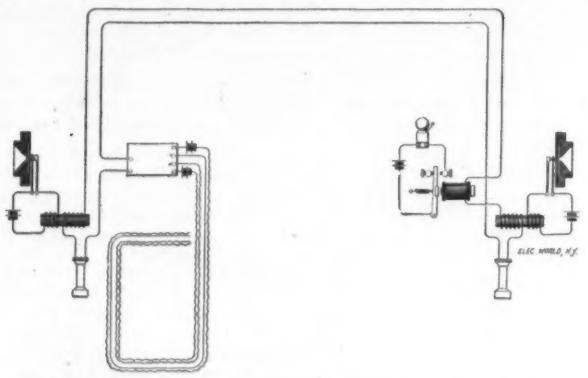
594,145. INDUCTOR DYNAMO; C. P. Steinmetz, Schenectady, N. Y. App. filed Aug. 12, 1897. An inductor dynamo, comprising a revolving inductor and a stationary armature, the latter having portions of laminated iron and a solid yoke, with an auxiliary or additional air gap in the armature iron.

594,150. STARTING DEVICE FOR ALTERNATING CURRENT MOTORS; W. J. Foster, Schenectady, N. Y. App. filed Jan. 4, 1896. As a means of increasing the starting torque of a synchronous alternating current motor, a bridge of magnetic material adjacent to the polar faces of the induced member.

594,155. SECTION INSULATOR; J. Hoffman, Schenectady, N. Y. App. filed Aug. 7, 1897. In a section insulator, a main portion or body of insulating material, and metallic end pieces secured to the main portion, and having a transverse flange or rib engaging the main portion.

594,156. RONTGEN RAY TUBE; J. W. Howell, Newark, N. J. App. filed Aug. 26, 1897. The art of regulating the vacuum in a Röntgen ray tube, which consists in passing a current proportional to the resistance of the tube through a suitable salt in a vacuous inclosure, and thereby volatizing the salt in accordance with the degree of vacuum desired.

594,192. AUTOMATIC ELECTRIC BURGLAR ALARM; J. W. Baughman, Dalton, Ohio. App. filed March 25, 1897. An electric alarm system, comprising the vibrating bell, having terminal connecting posts, a lever provided with a pin projecting into the the path of the hammer arm, a conductor connecting said lever with the post, a contact located in the path of one end of said lever, and in electrical connection with a post through the conductor post, magnet and a second conductor, a contact post connected to the terminal post by another conductor, and a local battery having its poles con-



No. 594,034.—Automatic Circuit Controller.

nected to the terminal posts in combination with the alarm circuit, its battery and spring connections.

594,227. ELECTRIC SWITCH; A. C. Brockies, London, England. App. filed June 7, 1897. The combination of a base, a pair of contacts fixed to the base, a contact pivoted to the base, consisting of a U-shaped conducting plate, the sides of whose free ends respectively engage the contact faces of the fixed contacts, and a tensional spring having one end fixed to the base, and the other end to the pivoted contact, the positions of the points of attachment being such that when the pivoted contact is moved from one extreme position to the other the spring crosses from one side to the other of the pivot.

594,247. ELECTRIC CABLE; J. D. Gould, Brooklyn, N. Y. App. filed Jan. 11, 1897. An electric cable, comprising a fusible core, an insulating material covering the same, a series of conductors wound spirally around said insulating material, and an insulating cord wound between adjacent spirally-wound conductors.

594,256. ELECTRIC RAILWAY SIGNAL AND SAFETY DEVICE; K. Kohn, Seward, Neb. App. filed March 8, 1895. The combination with an electric conductor alongside the track, and devices on the train maintaining electric contact with said conductor, of a steam valve, a lever carried by the spindle of said valve, an armature engaging said lever, two coils and the wire connections for energizing the same, a rod normally pressed outward, and pivoted movable connections between said rod and the upper end of said lever.

594,281. AUTOMATIC SIGNALING SYSTEM; C. W. Price, Newark, N. J. App. filed Jan. 11, 1897. In an electro-mechanical controller for an electric circuit, comprising a motor, a screw shaft operated by said motor, a circuit making and breaking disc for a main circuit on said screw shaft, a pivoted lever movable by said screw shaft, and adapted to stop the motor after a certain number of rotations of the circuit controlling disc shall have been made, an electromagnet in a local circuit, an armature lever operated by said electromagnet for releasing the motor, a spring plate for locking the armature lever, and a lever serving to move the spring plate out of engagement with the armature lever, and also serving to return the locking lever to its normal position.

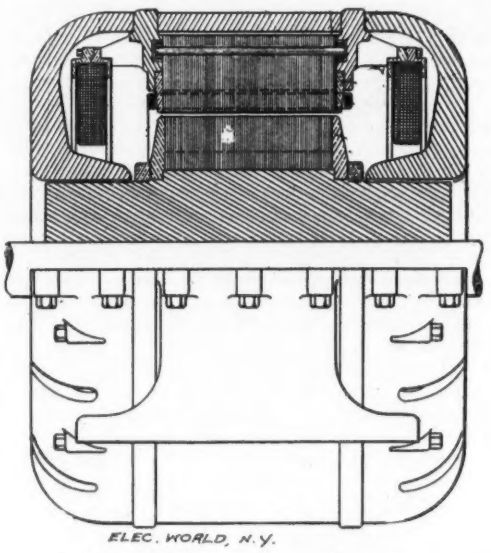
594,300. RAILWAY SIGNAL; J. D. Taylor, Chillicothe, Ohio. App. filed April 2, 1897. In an electric signal system, a relay, comprising a pair of electromagnets, pivoted armature levers coacting therewith, contacts carried by the armature levers, front and back contact pieces for engagement with the contacts carried by the levers, rock shafts on which the armature levers are mounted, arms rigidly mounted on the rock shafts and arms loosely mounted on the rock shafts, the loose arm of one shaft being adapted to interlock with the rigid arm of the other shaft.

594,306. ELECTRIC TIME SWITCH; A. B. Williams, Waco, Tex. App. filed July 7, 1897. An automatic electric switch, comprising rocking levers carrying contact plates, the contact plates being insulated from the levers, means for moving said plates directly from each other without rubbing action, a cam for governing each lever, the two cams being of like construction, means for adjusting the cams one relatively to the other, and time mechanism for rotating the cams.

594,313. STORAGE OR SECONDARY BATTERY; R. Ashley, Port Republic, N. J. App. filed April 25, 1896. In a secondary or storage battery, the combination with super-imposed trays or cups each consisting of a rectangular base, outwardly flaring, upwardly extending sides and supporting lugs on the inner sides at the corners thereof, with spaces between said lugs, of the conductors running along the outside of the trays, and then down the inside thereof, and the electrodes.

594,323. MEANS FOR INDICATING MOVEMENT OR CESSATION OF MOVEMENT OF FLUIDS; O. Carpenter, Pawtucket, R. I. App. filed Dec. 5, 1896. A device comprising a body in a fluid, the body being heavier than the fluid, and arranged to be moved by the pressure of the fluid when the fluid is in motion, and a magnet exterior of the said fluid and body, and so arranged that the body may come within and leave the field of said magnet, to cause a disturbance thereof.

594,346. HEAT REGULATING APPARATUS; C. L. Fortier, Milwaukee, Wis. App. filed Sept. 12, 1896. The combination with a heat regulating valve or damper, of an electromagnet for controlling the operation of said



No. 594,145.—Inductor Dynamo.

valve or damper, an electric circuit connecting the coil of said magnet with a source of electricity, and a shunt containing a thermostat and tapping said circuit on opposite sides of said magnet.

594,363. TELEPHONE SYSTEM; A. F. Swan, Bayonne, N. J. App. filed Dec. 10, 1896. The combination with the telephone apparatus, the line, and the switch barrel having means for stepping it around, of the series of insulating and conducting strips on the switch barrel, a series of brushes to contact with the aforesaid strips, and connections between the brushes, the bell and talking set and the line, whereby one position of the switch barrel cuts the bell to line, the second position cuts the talking set to line, and the third position cuts the bell and talking set out of line by short circuiting.